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ORIGINAL (Red)

PHASE II INTERIM TASKS
FOR MORGANTOWN ORDNANCE WORKS SITE OU 1
MORGANTOWN, WEST VIRGINIA

Prepared For:

Morgantown Ordnance Works Site OU 1
Technical Committee

Prepared By:

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Wakefield, MA 01880

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PHASE II INTERIM TASKS
ORDNANCE WORKS SITE OU 1
MORGANTOWN, WEST VIRGINIA

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EXECUTIVE SUMMARY

This report presents information related to several investigatory and remedial activities undertaken in the first half of 1996 at Morgantown (WV) Ordnance Works, Operable Unit 1 (OU 1). OU 1 is the area where waste disposal occurred from past operations at the Ordnance Works site. Specific locations of past waste disposal and migration were targeted in these efforts, including the Lagoon Area and Scraped Area, both of which contain little or no vegetation amid a largely forested landscape; and three Drainage Swales that carry storm runoff from the Lagoon Area and Scraped Area. Activities discussed in this report include the following:

- Pre-design sampling and analyses of soils and sediments;
- Delineation and mapping of wetlands;
- Removal of investigation-derived waste (IDW) from past sampling efforts; and
- Construction of a perimeter fence.

PRE-DESIGN SAMPLING OF SOILS AND SEDIMENTS.

Soil in the Lagoon Area was overlain by black cinders in some areas. At a depth of 0 - 4 feet, soils were silt and clay, with frequent observations of fill material and tar. At 4 - 8 feet, soils were similar to shallower soil with some natural organic matter (i.e. twigs, roots) and less evidence of tar observed. In deepest borings, 8 - 12 feet, silty clay and clay was also encountered, with one observation of possible tar, laboratory analysis did not confirm this field observation. Refusal occurred at 8 to 11 feet in some borings, with weathered bedrock in the bottom of the sample core.

Soils in the Scraped Area were sometimes overlain by black cinders. As in the Lagoon Area, soils from 0-12 feet were silty clay and clay. Observations of tar decreased with depth, and no observations of tar were noted in the 8-12 foot interval.

Soil samples for chemical analyses were collected from the Lagoon Area and Scraped Area from discrete depths, using a grid pattern, with nodes 30 feet apart. Both grids required expansion because of evidence of coal tar (tar) along the planned perimeters. The original Lagoon Area grid (prior to any expansion) contained 54 sampling locations and measured 240 by 150 feet. The final grid contained 103 sampling locations and measured approximately 330 by 380 feet. The original Scraped Area grid contained 24 sampling locations and measured 90 by 150 feet. The final grid contained 36 sampling locations and measured approximately 150 by 350 feet.

Metals. Sampling for the metal contaminants of concern (arsenic, cadmium, lead and copper) was conducted at a total of ten locations (ten samples and one field duplicate) in the two areas that were reported (Weston, January 1988) to have elevated soil metals concentrations based on previous analytical results for the Site. No soil with metals concentrations above the ROD-specified action levels were encountered.

Carcinogenic Polycyclic Aromatic Hydrocarbons (cPAHs). Of a total of 179 samples analyzed from the Lagoon Area, 39 samples contained cPAH concentrations above the existing action level of 78 mg/kg. The majority of these detections were located at a depth of 0-4 feet, and were randomly distributed. Several were found to the south and southwest, outside of the original sampling grid. Although most detections of cPAHs in the Lagoon Area were in the surficial soils, there were adjacent sample points in the western corner of the original sampling grid where medium to high concentrations of cPAHs were identified in the 8-12 foot sampling depth interval.

Of the 77 samples analyzed from the Scraped Area, 12 samples contained cPAH concentrations above the existing action level of 78 mg/kg. All of these detections were located in the upper 4 feet of soil, and were located in the northeast and south of the sampling grid, primarily outside of the original grid.

Of the 18 Drainage Swale #1 samples analyzed, 9 were above the 78 mg/kg action level, whereas 0 out of 10 of the Drainage Swale #2 and 1 out of 6 of the Drainage Swale #3 samples were above the action level. There appears to be a localized area of high cPAH contamination (concentrations above 1000 mg/kg) in Drainage Swale #1, in the DS1-03 to DS1-04 area.

Soil and Sediment Volumes Requiring Treatment. The Lagoon Area and Scraped Area excavation volume calculations resulted in estimates of approximately 10,000 cy and 2,200 cy, respectively. The Drainage Swale excavation volume calculations resulted in an estimate of approximately 200 to 300 total cy of soil above action levels in the three swales.

WETLANDS DELINEATION

A single jurisdictional wetland associated with the landfill in the northeastern portion of the property was identified. Although additional wet areas were encountered during the site walkover, these other habitats are primarily intermittent drainages that lack one or more wetland attributes. It was concluded that no other jurisdictional wetlands exist at, or immediately downgradient of the property. The palustrine wetland located within the fenced area at OU1 is contiguous with a narrow wetland area adjacent to Drainage Swale #3 that continues to the railroad tracks. Due to the close proximity of the wetland to the eastern edge of the landfill, capping activities are highly likely to result in impacts to the western portion of wetland. Drainage Swale remedial activities are not expected to have an extensive effect on the wetland.

DRUM REMOVAL

Thirteen drums were present at OU1 prior to their removal in February 1996. The drums were appropriately overpacked, labeled, removed from the site, and transported under Olin's direction to an appropriate disposal location.

FENCE INSTALLATION

The fence installed at OU1 is 3,197 feet long and consists of 11 gauge galvanized chain link, 6 feet high with three strands of barbed wire. Locked double drive gates, each 12 feet wide, provide vehicle access.

1.0 INTRODUCTION

1.1 PROGRAM OVERVIEW

The efforts described in this report comprise the Phase II Interim Tasks - Pre-design Sampling portion of the remedial design/remedial action (RD /RA) project for Operable Unit 1 (OU 1) at the Morgantown Ordnance Works, Morgantown, West Virginia. Figure 1-1 presents an overview of the general vicinity and Figure 1-2 shows OU 1, the study area of this project.

The four tasks described in this report, were conducted by or on behalf of Olin, which has responded to EPA's Unilateral Administrative Order, and include the following:

- Removal and disposal of drums of investigation-derived waste (IDW) remaining on the site as a result of past field work conducted for EPA.
- Construction of a perimeter fence.
- Wetlands delineation.
- Pre-design Sampling.

The first two tasks on the above list were performed in order to secure the site while remedial design activities are progressing. Wetlands delineation will assist the design of the cap for the existing landfill by clearly showing areas where wetlands may be affected by alternative landfill cap configurations. Pre-design Sampling will primarily assist in determining the areas and volumes to be addressed in the design of the treatment system for soils that contain carcinogenic polycyclic aromatic hydrocarbons (cPAHs). In addition, Pre-design Sampling clarifies the status of metals-contaminated soils which, in the ROD's preferred remedy, if present, are to be solidified and placed on the landfill before capping.

The overall goal of this project is to execute the provisions of the Record of Decision (ROD), issued by the U.S. Environmental Protection Agency (EPA) on September 29, 1989. As discussed in the 1989 ROD, the major components of the Preferred Remedial Action involved: (1) excavation and solidification of inorganic contaminants and placement of solidified, non-hazardous material into the existing landfill: (2) excavation and treatment of organic contaminants using bioremediation; (3) installation of a multi-layer RCRA Subtitle C cap on the

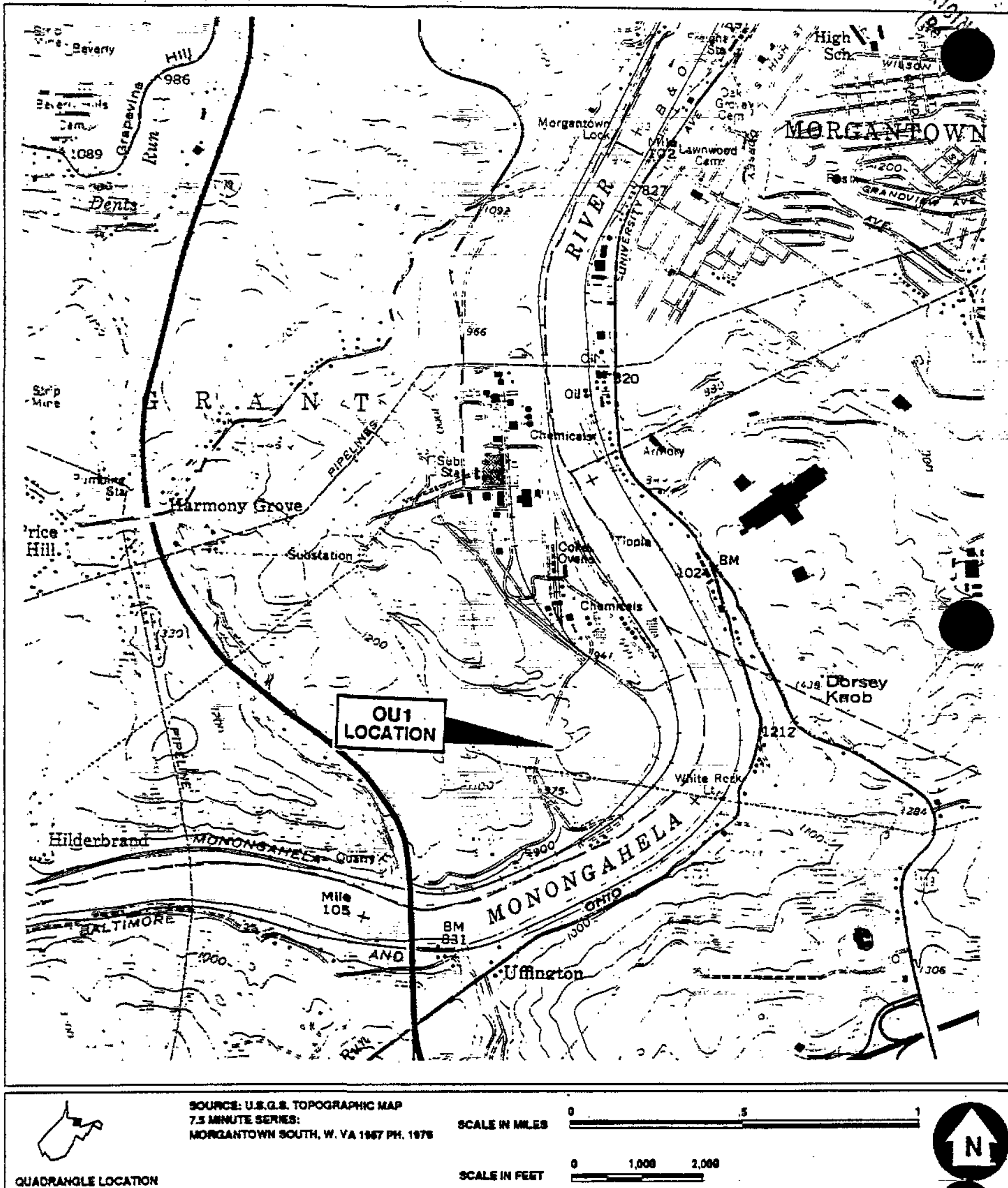

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FIGURE 1-1
SITE LOCATION
MORGANTOWN ORDNANCE WORKS SITE
MORGANTOWN, WV

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landfill and regrading/revegetation to control surface run-on and run-off; (4) short-term environmental monitoring to ensure effectiveness of the remedial action; (5) ground water monitoring in the immediate vicinity of the landfill and (6) deed restrictions to prohibit residential and industrial construction in the landfill area and residential construction in the remaining areas. Tasks associated with implementation of the Preferred Remedial Action are detailed in Figure 1-3 of the Phase I Remedial Design for Morgantown Ordnance Works Site OU1 Workplan (ABB-ES, December 1992).

According to the ROD, the Remedial Investigation/Feasibility Study Report (RI/FS: Roy F. Weston, January 1988), and the Focused Feasibility Study Report (FFS: NUS, June 1989), the vast majority of the contaminated material to be treated at OU 1 is located in the former Lagoon Area and contains total carcinogenic polycyclic aromatic hydrocarbons (cPAHs) above the EPA-specified action level of 44.7 mg/kg[1]. The material to be treated for removal of cPAHs was given a "preferred" remedy of bioremediation in the ROD, with a "contingency" remedy of soil washing if treatability testing showed bioremediation not to be feasible. A smaller volume of soil in the OU 1 area was believed at the time when the ROD was being prepared to contain metal contaminants of concern (arsenic, cadmium, lead, copper) above action levels. If soils containing these metals above action levels were identified during Pre-design Sampling, then these soils were to be solidified. This solidified material would be placed on the existing landfill before capping it.

The goal of this Pre-design Sampling phase of the RD/RA project was to evaluate soil conditions in three areas (Lagoon Area, Scraped Area, Drainage Swales) of OU1 with regard to the concentrations of cPAHs and metals. This information is to be used as the basis of design for the bioremediation treatment system and, if necessary, solidification of metals-bearing soils.

1.2 SITE BACKGROUND INFORMATION

1.2.1 Facility History

A detailed description of the Morgantown Ordnance Works Site ownership and manufacturing history is presented in the Phase I Remedial Design Workplan (ABB-ES, May 1994).

[1] This target has been revised to conform with more recent EPA guidance (Letter, Olin to EPA July 28, 1995; Letter, EPA to Olin April 26, 1996). This more recent guidance takes into account updated slope factors that reflect varying toxicity of the individual cPAH compounds. The revised target at this time is 78 mg/kg total cPAHs, but this target may change depending on the specific concentrations of individual cPAH compounds. Most references to a cPAH target in this report use 78 mg/kg. Whatever target is chosen, the results of the Pre-design Sampling reported herein will provide a basis for remedial design. This report often refers to the target simply as the "cPAH target", without a numerical specification.

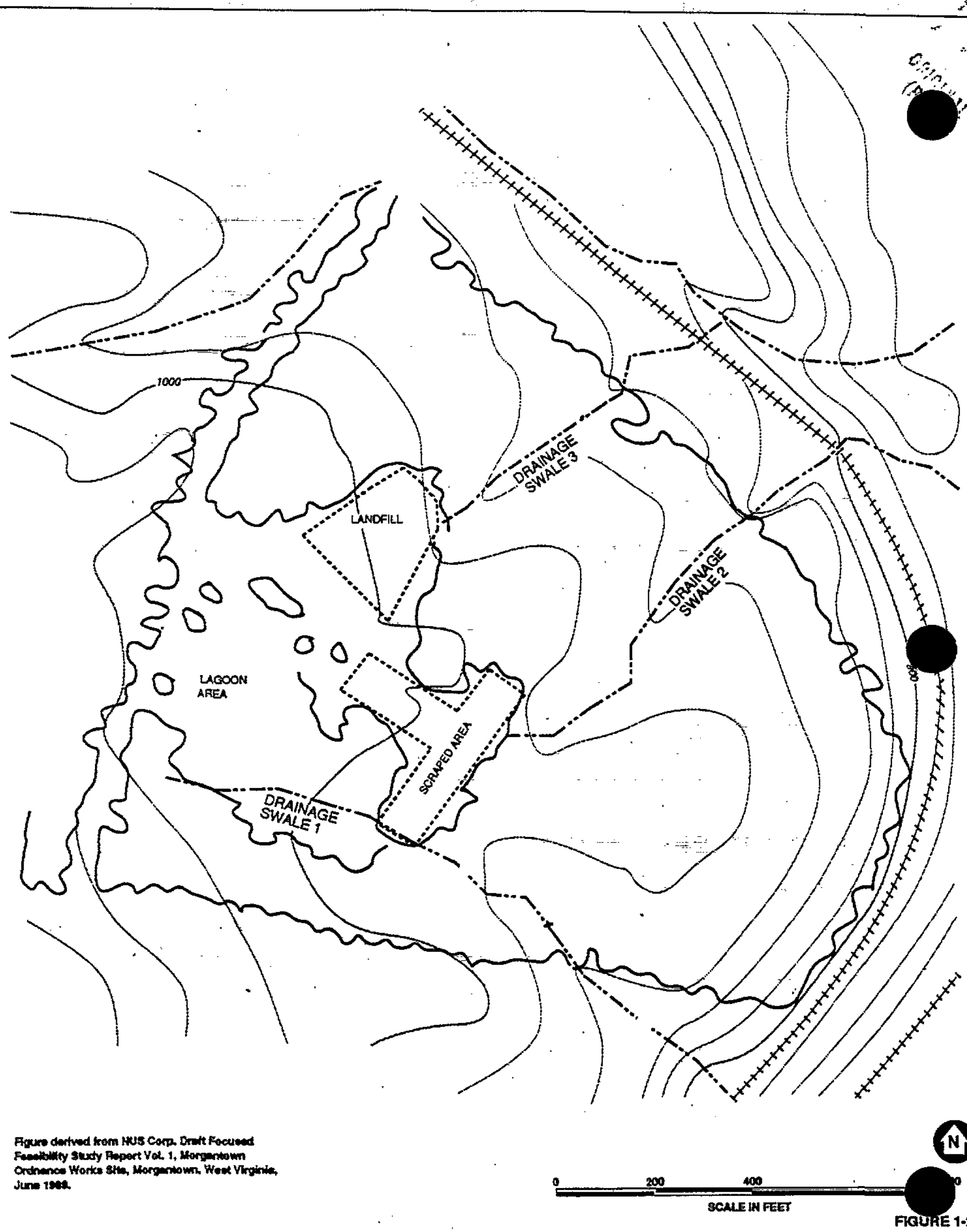

Figure derived from NUS Corp. Draft Focused Feasibility Study Report Vol. 1, Morgantown Ordnance Works Site, Morgantown, West Virginia, June 1989.

FIGURE 1-2
OU 1 - GENERAL SITE MAP
MORGANTOWN ORDNANCE WORKS SITE
MORGANTOWN, WV

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1.2.2 Previous Investigations

Studies and remedial activities at the Morgantown Ordnance Works site began in 1981 and have continued to the present. Table 1-1 presents a chronology of remedial and regulatory events relevant to the Morgantown Ordnance Works Site. The majority of past sampling activity focused on approximately 6 acres at the southern portion of the Site, which is the location of OU 1.

Samples were also collected at the northern portion of the Site, including the abandoned Department of Defense process and utility areas, during a Site Inspection (SI) and Remedial Investigation and Feasibility Study (RI/FS). This area is located within the second operable unit (OU 2), which has been addressed by a separate RI/FS.

Following completion of the EPA-initiated RI/FS in January 1988, a ROD for OU 1 was issued in March 1988. In response to comments received from several parties on this initial ROD, EPA prepared a Focused Feasibility Study (FFS) to re-evaluate the remedial alternatives considered in the March 1988 ROD. After completion of the FFS in June 1989, EPA developed a new Proposed Remedial Action Plan. A second ROD, which superseded the original ROD, was issued by EPA in September 1989. The target contaminants in the second ROD were identified as cPAHs and four heavy metals (arsenic, cadmium, lead, copper).

In June 1990, EPA Region III issued an Administrative Order to several Potentially Responsible Parties (PRPs) to perform RD/RA under Section 106 of the Comprehensive Environmental Response, Compensation and Liability Act of 1981 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986. Those parties who received the RD/RA Order were General Electric Company, Olin Corporation, Rockwell International and the current owners of the Site, Morgantown Industrial Park Associates, Limited Partnership (MIPA).

1.3 Scope & Objective of Current Field Program

The objective of this Pre-design Sampling program was to characterize soil conditions in three areas of concern: Lagoon Area, Scraped Area, and Drainage Swales. This characterization had as its primary goal the quantitation of volume, and the delineation of location, of soils contaminated with cPAHs above the cPAH target (78 mg/kg). This information is necessary for the design of the soil bioremediation treatment system to be used to remediate cPAH contaminated soils. Characterization was done by collecting samples which were representative of soil in the three areas of concern. The sampling locations in the Lagoon and Scraped Areas were determined by constructing a rectangular grid for each area and selecting nodes on the grid as sampling locations (Figure 1-3). Drainage Swale sampling locations for the three swales were chosen to evaluate one sediment sample per 100 feet of length of swale (Figure 1-3). All samples were collected as grab samples, and as such represent specific, discrete locations in each of the three areas.

The sample locations, frequency, and collection and handling protocols used for this effort are described in the Phase II Interim Tasks Work Plan (ABB-ES, November 1995). Discrete soil samples were collected in order to permit the delineation of cPAH contamination. Samples analyzed by the ABB-ES Wakefield Laboratory were reported back to the field team within two days, so that the density of sampling in any area or the overall size of sampling grids could be adjusted as needed.

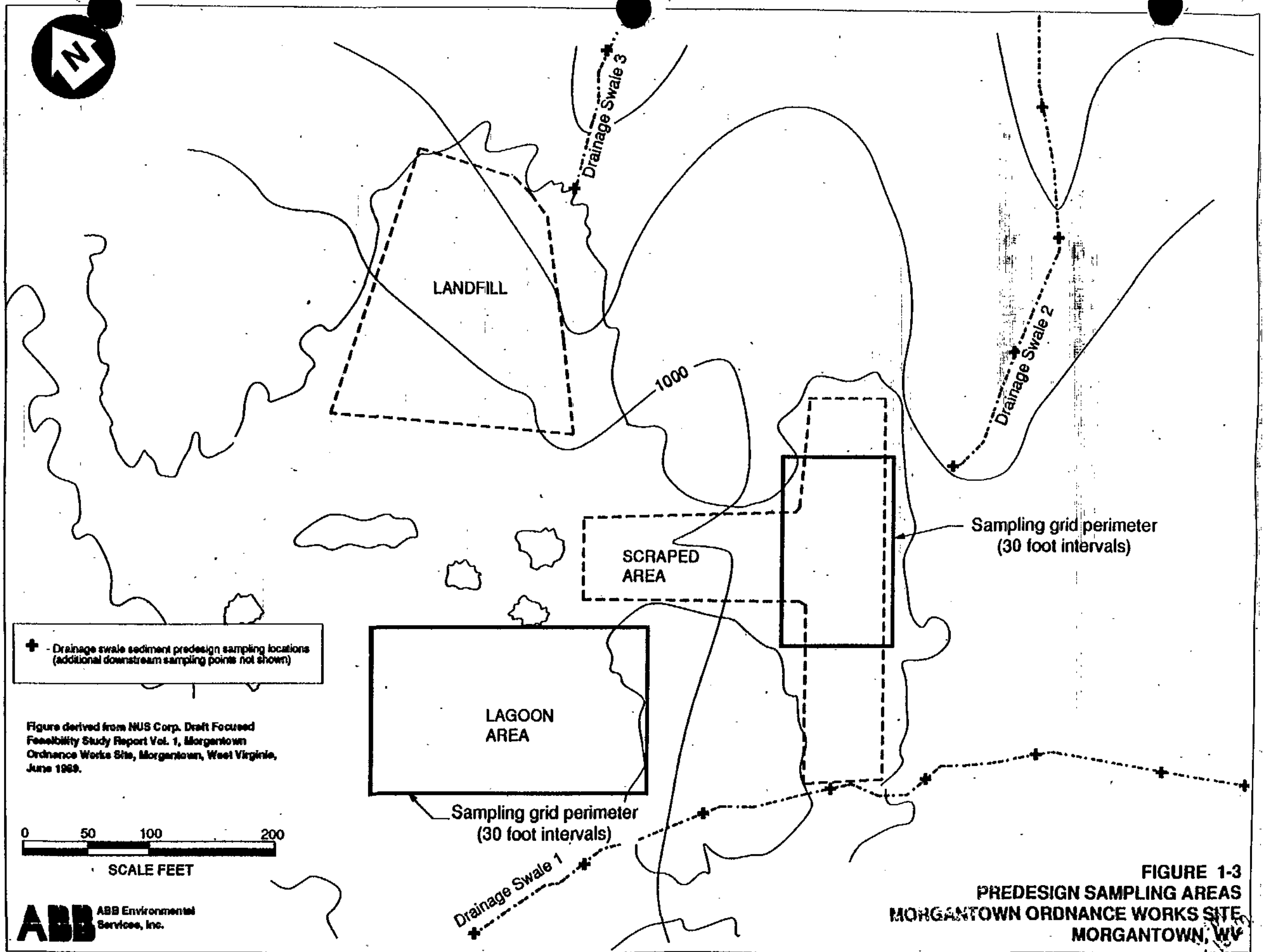

Figure derived from NUS Corp. Draft Focused Feasibility Study Report Vol. 1, Morgantown Ordnance Works Site, Morgantown, West Virginia, June 1989.

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FIGURE 1-3
PREDESIGN SAMPLING AREAS
MORGANTOWN ORDNANCE WORKS SITE
MORGANTOWN, WV

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Table 1-1: Previous Studies/Remedial Activities at The Morgantown Ordnance Works Site

DATE	EVENTS
February - November 1981	Rockwell International Corp excavated two lagoons formerly used for chrome plating waste disposal. Excavated material was disposed in an off-site landfill.
April 1983	EPA's Field Investigation Team (FIT) team performed an SI at locations believed to be the waste disposal and handling areas used by former tenants, which included an inactive landfill, Scraped Area adjacent to the landfill, two dredged lagoons and PCB drums staging area. Air samples were also collected at locations throughout the Site.
March 1984	MSES Consultants, under contract to MIPA, collected samples from drums containing PCB-contaminated liquids and from surrounding soil.
May 1984	EPA's FIT team issued an SI report, documenting the results of sampling activities. FIT indicated that several drums contained PCB-contaminated liquids; soils and sediments collected adjacent to the landfill and Scraped Area contained PAHs at concentrations exceeding 100 ppm; blue pellets collected from the surface of the landfill were composed primarily of zinc and copper; a yellow solid material collected from the Scraped Area was composed primarily of sulfur; and that the results from air monitoring revealed no site-related hazards.
May-June 1984	MSES Consultants, under contract to MIPA disposed of drums containing PCBs at an approved off-site facility.
July 1984	EPA's FIT team conducted a follow-up inspection and sampling to determine effectiveness of MIPA response action. Soils in the former drum staging area were found to contain "hot spots" of PCBs up to 229 ppm. PAHs and heavy metals (e.g., arsenic, chromium, copper, lead, mercury, nickel and zinc) were detected in surficial soils at the landfill and Scraped Area, as well as stream sediments, in concentrations exceeding background levels.
October 1984	MSES, under contract to MIPA, removed PCB-contaminated soils from the drum staging area and disposed material at an approved off-site facility.
October 1984	Morgantown Ordnance Works proposed for inclusion on the National Priorities List (NPL).
March 1985	EPA initiated an RI/FS at the southern portion of Morgantown Ordnance Works, which focused primarily on the landfill, scraped, lagoon and drum staging area. The RI/FS also involved limited sample collection at areas in the northern portion of the Site, such as the abandoned Department of Defense process and utility areas.
June 1986	Morgantown Ordnance Works promulgated to the final NPL.
January 1988	EPA issued the final RI/FS report, which documented the presence of hazardous substances, pollutants and/or contaminants at the landfill, Scraped Area, former Lagoon Area and stream sediments.
March 1988	EPA issued the first ROD for OU 1.
December 1988	Several PRPs submitted comments, including a report by Woodward-Clyde Consultants, regarding the remedy selected by EPA in the March 1988 ROD.
June 1989	EPA prepared a Focused Feasibility Study (FFS) in response to comments received from several PRPs regarding remedy selection.
September 1989	EPA issued a second ROD for OU 1, which superseded the original ROD.
June 1990	EPA issued a Unilateral Administrative Order to Olin for performance of RD and RA at OU 1.
August 1990	Olin notified EPA regarding selection of ABB Environmental Services, Inc. (ABB-ES) to perform RD/RA work at OU 1.
February 1991	EPA notified Olin regarding acceptance of ABB-ES as RD/RA contractor.
March 1991 - January 1993	Work Plan preparation and negotiations
February 199[illegible] ary 1994	Initial screening studies - cPAH Treatability
October 1994 - January 1995	Further screening studies - cPAH Treatability

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2.0 FIELD EFFORT

Soil borings in the Lagoon and Scraped Areas were conducted on 30 foot on center sampling grids, using the GeoProbe technique. The GeoProbe technique utilizes a hydraulic ram to push a thin-walled steel tube into the ground. Soil cores of 1.0 inch diameter (2-foot sampling tube length) and 1.5 inch diameter (4-foot sampling tube length) were used. Drainage Swale samples were taken from the top 6-inches of soil at 100-foot intervals in each of the three Drainage Swales using a stainless steel sampling spoon.

In accordance with the approved workplan, the soil samples collected were sent to the ABB-ES laboratory in Wakefield, Massachusetts and analyzed for cPAHs. In addition, a subset of samples was analyzed by ABB-ES for grain size distribution by (ASTM D422-63) Standard Test Method for Particle-Size Analysis of Soils and by NET (Bedford, MA) for Total Organic Carbon (TOC) by EPA Method 415.1. Selected samples were sent to the Environmental Science & Engineering laboratory (ES&E) (Gainesville, FL) for metals analyses. Confirmatory cPAH analyses were sent originally to ES&E (Peoria, IL) however ES&E cPAH procedures and data were audited and were found to be unacceptable. ES&E confirmatory cPAH results have not and will not be used in the evaluation of the extent and degree of cPAH contamination at OU1. Confirmatory resampling samples were sent to IEA (Cary, NC). The ABB-ES and IEA cPAH laboratory results, and visual and olfactory observations from samples analyzed, were used to delineate the specific areas of concern that will be addressed by the remedial actions to be instituted for the OU1 area.

2.1 Overview of Field Activities

The on-site portion of the Pre-design Sampling field program began on February 1 and continued through February 18, 1996. The February field effort was originally intended to constitute the entire sampling effort for the Pre-design Sampling task. However, due to quality control deviations associated with the confirmatory cPAH analyses that occurred following the February sampling, an additional sampling effort was conducted in May. Additional confirmatory sampling was conducted on May 7 through May 9, 1996. The May effort included resampling and analyses of all those locations sampled in February from which confirmatory cPAH samples were taken. Additional details regarding the resampling are discussed in Section 3.1.

Observations made while conducting sampling activities were documented by recording them on field sampling forms and/or in a field logbook, dedicated to the project. Information recorded includes but is not limited to the following: weather conditions; time of arrival and departure from the site; names of field personnel present and their responsibilities; sample locations; matrix and depth; significant visual and olfactory observations; and monitoring equipment used and results.

A total of three ABB-ES field personnel were present throughout the period of on-site activities. The composition of the three person field team varied over the course of the field effort. Performance auditing of the ABB-ES field activities was provided by a representative from Law Environmental who was present for the first 12 days of the field activities in February and for the entire re-sampling program in May.

2.1.1 General Field Conditions

Field conditions at the Site during the February 1996 pre-design sampling field program were generally cold and wet with air temperature ranging from approximately 0 to 35 degrees F during the daytime hours. There was precipitation in the form of light snow on an almost daily basis. Snow-cover at the Site was approximately 1 to 4-inches throughout the field program. During the May 1996 re-sampling program, weather conditions consisted of light rain and moderate daytime temperatures of approximately 60 degrees F. During both field efforts, surface soils were moist to wet due to the continuing precipitation and therefore dust generation did not occur.

2.1.2 Grid Set-Up

The sampling in the Lagoon and Scraped Areas was performed based on grids with 30 foot node spacing developed for the each of the areas (Figure 2-1, 2-2 respectively). These locations were designed to encompass all areas previously determined to be contaminated with cPAHs above the cPAH target, based on analytical data provided in the Weston, 1988 RI/FS Report.. Grids were subject to change as a result of conditions encountered during the field program.

The grids in the Lagoon Area and Scraped Area were set up on the same orientation: 40 and 130 degrees magnetic bearings, with adjacent nodes separated by 30 feet. The original Lagoon Area grid contained 54 sampling locations and measured 240 by 150 feet. The original Scraped Area grid contained 24 sampling locations and measured 90 by 150 feet.

The sampling locations on the grids were initially identified using flexible metal marker flags (pin flags). Following soil sampling at any given location, the pin flag was replaced with a 1.5- by 1.5-inch wooden stake of 2 foot length which had the sample location identification code written on it. These wooden stakes were left in place and were subsequently surveyed and mapped by Triad Engineering Inc. of Morgantown. This survey is included as Appendix A.

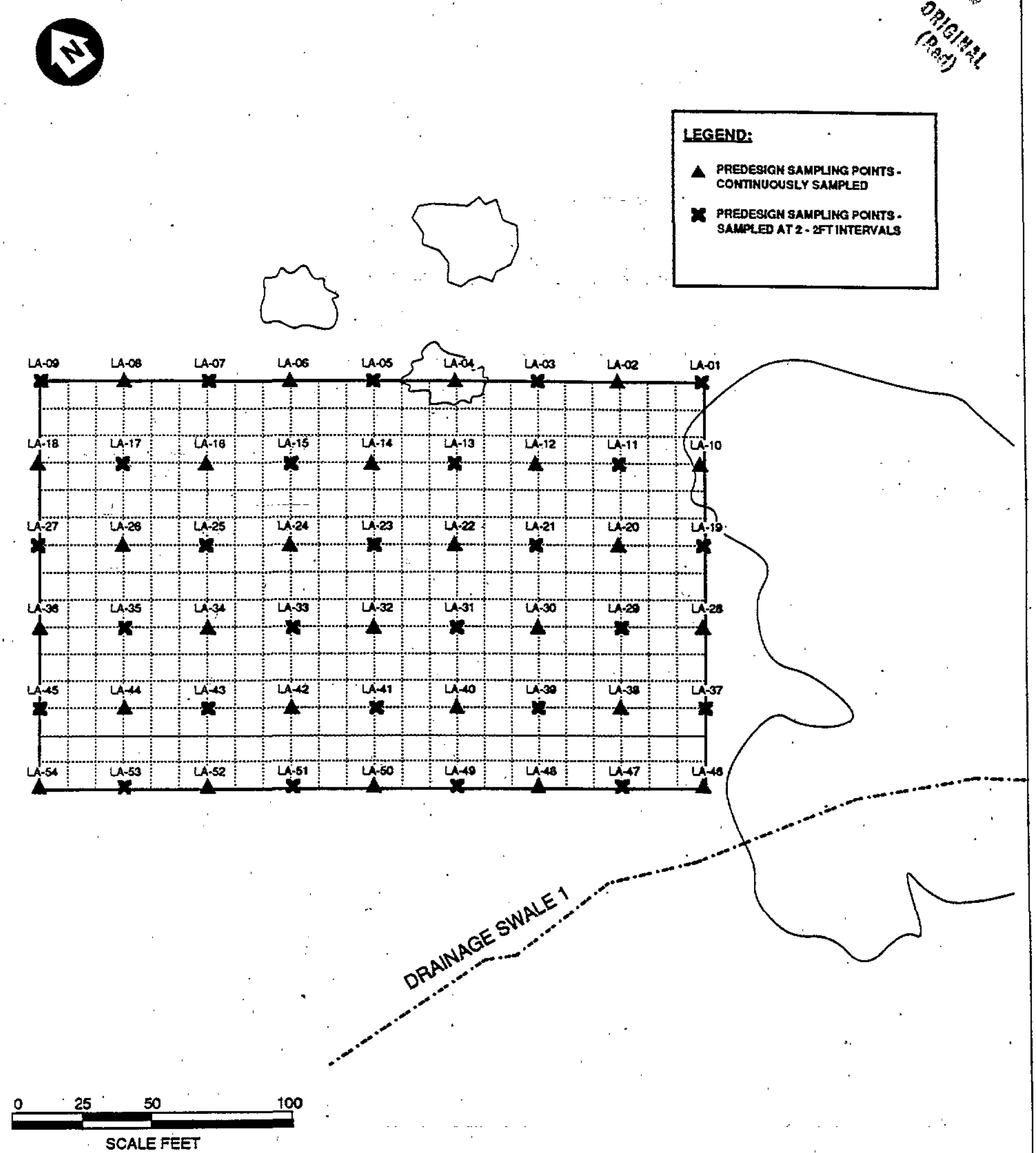

Figure derived from NUS Corp. Draft Focused Feasibility Study Report Vol. 1, Morgantown Ordnance Works Site, Morgantown, West Virginia, June 1989.

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FIGURE 2-1
LAGOON AREA SAMPLING GRID - INTIAL CONFIGURATION
MORGANTOWN ORDNANCE WORKS SITE
MORGANTOWN, WV

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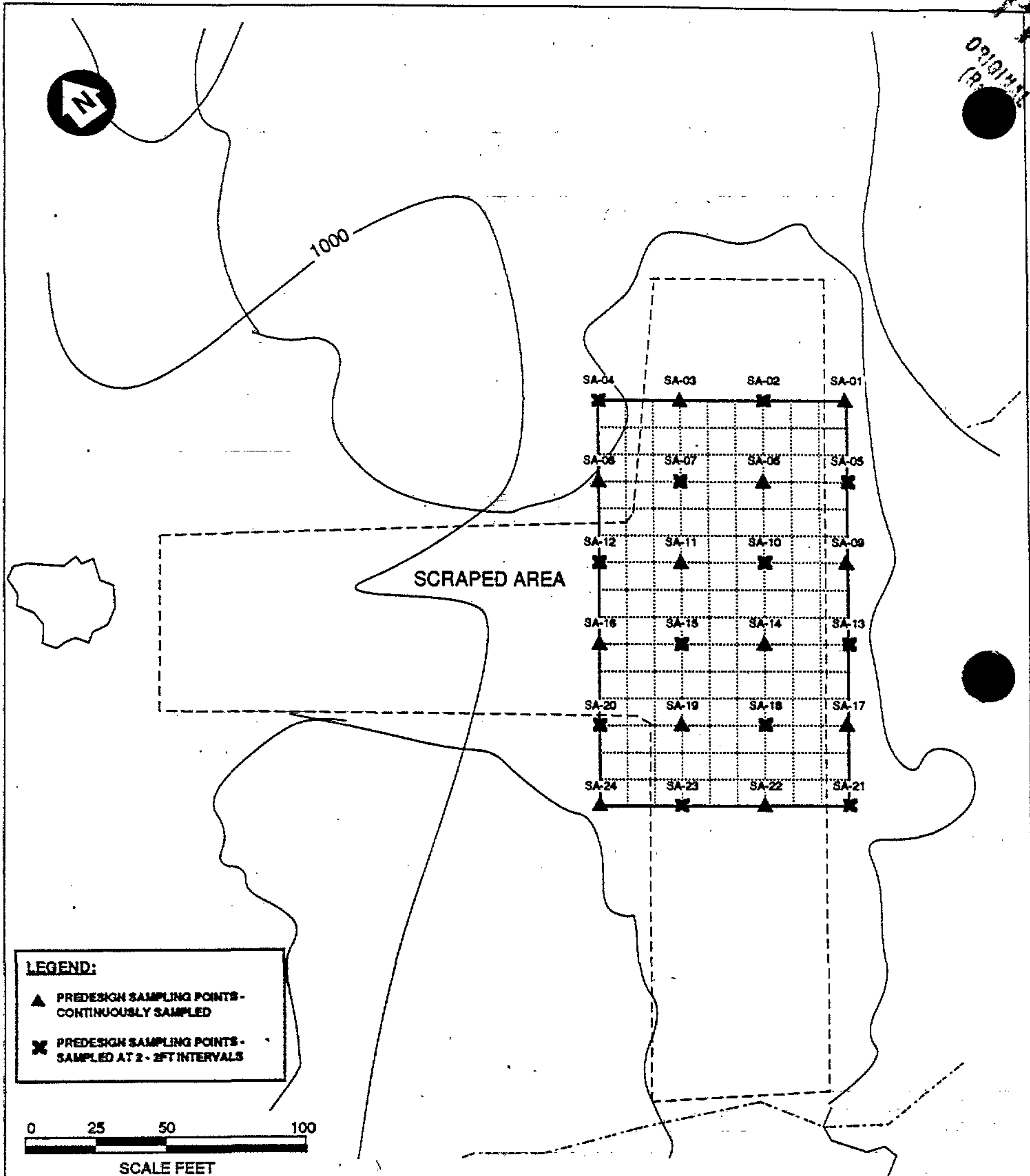

Figure derived from NUS Corp. Draft Focused Feasibility Study Report Vol. 1, Morgantown Ordnance Works Site, Morgantown, West Virginia, June 1988.

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FIGURE 2-2
SCRAPED AREA SAMPLING GRID - INTIAL CONFIGURATION
MORGANTOWN ORDNANCE WORKS SITE
MORGANTOWN, WV

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Sampling for the metal contaminants of concern (arsenic, cadmium, lead and copper) was conducted at a total of ten locations (ten samples and one field duplicate) in the two areas that were suspected to have elevated soil metals concentrations based on previous analytical results for the Site (Weston 1988). These two areas were the location of the former soil boring 9 (BOR-9, Weston, 1988) and the location of the former Scraped Area test pit 2 (SCA-02, Weston, 1988), refer to Figures 2-3 and 2-4, respectively.

2.1.3 Marking Drainage Swales

Drainage Swale sampling locations were marked at 100 foot intervals using pin flags (Figure 1-3). The pin flags were replaced by wooden stakes after sampling and the sample locations were surveyed, as was done in the Lagoon and Scraped Areas.

2.1.4 Boring Techniques and Approach

Drainage swale sampling locations for the three swales were chosen to evaluate one sample per 100 ft. of swale length. Soil samples of the top six inches of the Drainage Swales were collected using a stainless steel spoon. Based on visual evidence of coal tar (tar) on the ground, a small additional grid was set up and sampled in the upper reach of Drainage Swale 1 (Figure 2-5).

Soil borings in the Lagoon and Scraped Areas were conducted on 30 foot on center sampling grids, using the GeoProbe technique. The GeoProbe technique utilizes a hydraulic ram to push a thin-walled steel tube into the ground. Soil cores of 1.0 inch diameter (2-foot sampling tube length) and 1.5 inch diameter (4-foot sampling tube length) were used.

Alternate points on the sampling grids were continuously sampled from the soil surface to 12 feet below ground surface (bgs) resulting in three 4-foot long sample cores being taken at each even-numbered grid point. These continuously sampled borings were conducted as the first phase of this investigation. Based on visual observation of the continuous soil cores, two soil samples were chosen for cPAH laboratory analysis. As the second portion of the field investigation, the remaining grid nodes were sampled at two preselected 2 foot intervals within 12-feet of the ground surface. These intervals were selected based on the observations of and analytical results from the adjacent continuously sampled soil borings.

Geoprobe sampling tubes of 4-foot (continuously sampled nodes) and 2-foot (pre-selected depth nodes) length were used. An acrylic liner was used in conjunction with the sampling tubes. After extraction from below ground, the acrylic liner containing the soil sample was removed from the steel sampling tube. The liner was slit open and selected portions of the soil sample were placed in sample jars, logged, and field screened for VOCs. ABB-ES recorded all visual and olfactory observations as well as the results from the PID screening in the field logbook and soil boring logs. The soils encountered were described regarding particle size, color, texture, moisture content and other significant features. In addition, the total depth of the bore holes and the depth intervals from which samples were taken were recorded. Any other significant or unusual conditions were also recorded.

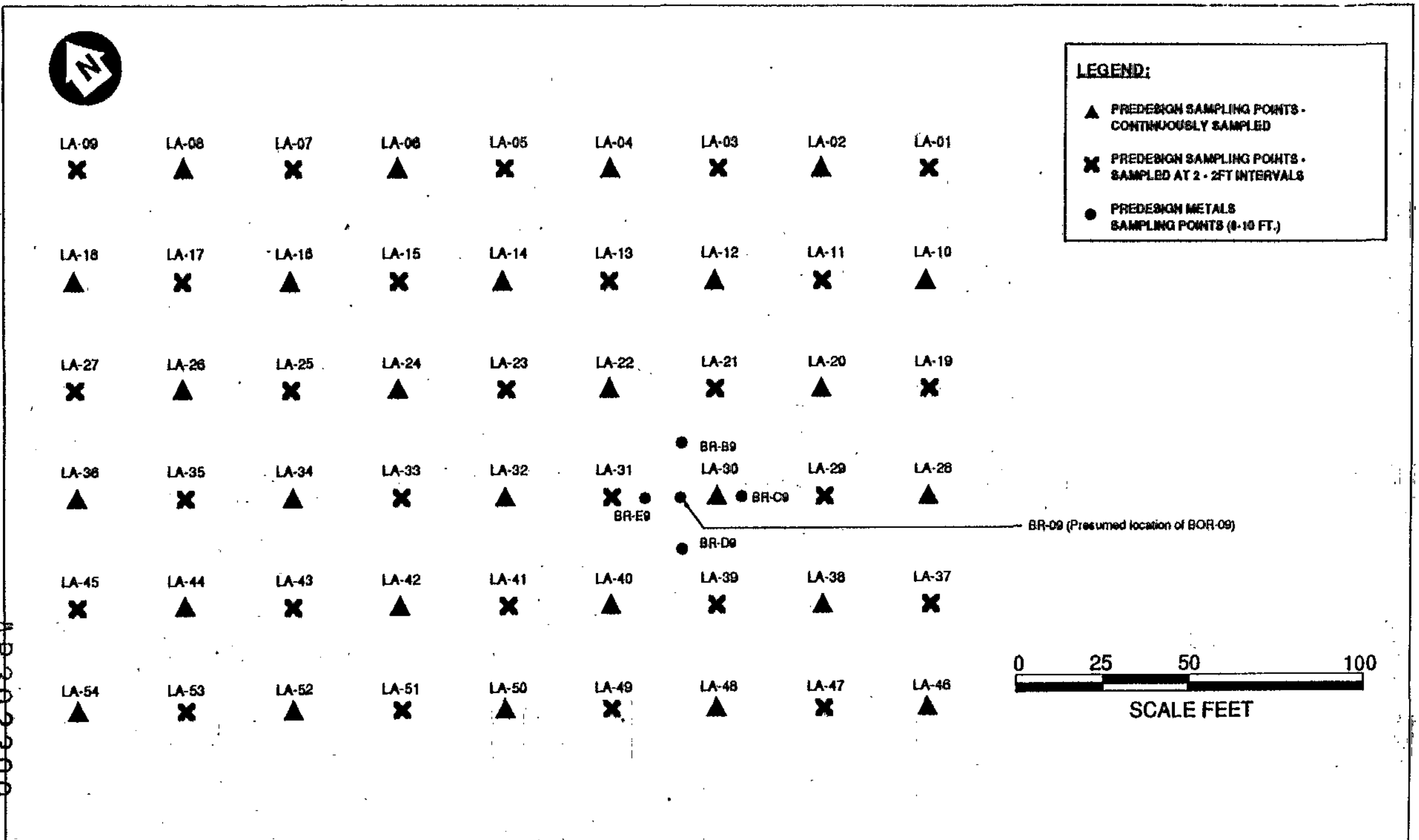

Figure derived from NUS Corp. Draft Focused Feasibility Study Report Vol. 1, Morgantown Ordnance Works Site, Morgantown, West Virginia, June 1989.

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FIGURE 2-3
LAGOON AREA METALS SAMPLING LOCATIONS
MORGANTOWN ORDNANCE WORKS SITE
MORGANTOWN, WV

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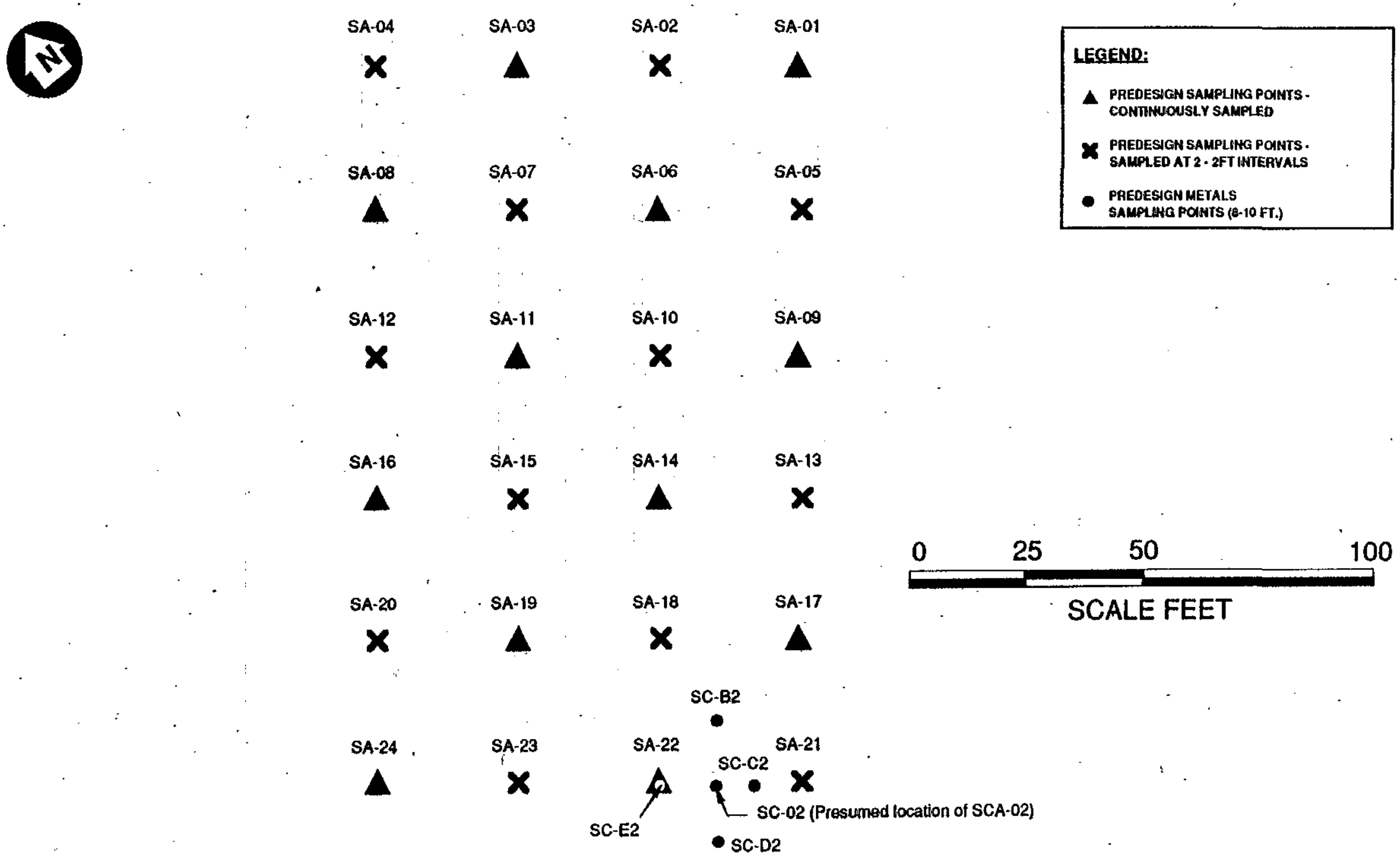

Figure derived from NUS Corp. Draft Focused Feasibility Study Report Vol. 1, Morgantown Ordnance Works Site, Morgantown, West Virginia, June 1989.

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FIGURE 2- 4
SCRAPED AREA METALS SAMPLING LOCATIONS
MORGANTOWN ORDNANCE WORKS SITE
MORGANTOWN, WV

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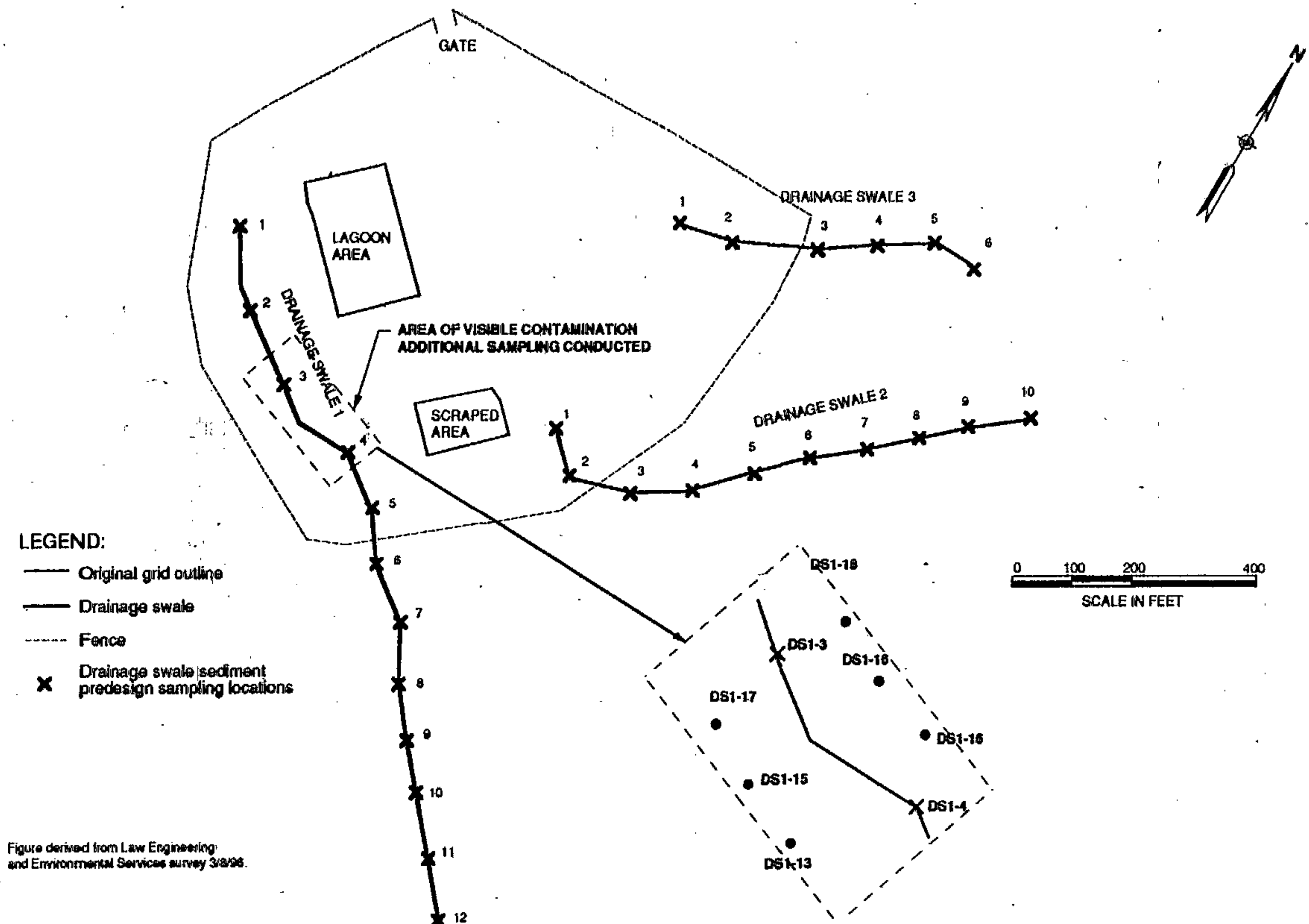

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FIGURE 2-5
DRAINAGE SWALES SAMPLING LOCATIONS - FINAL CONF ATIONS
MORGANTOWN ORDNANCE S SITE
MORG WN, WV

At completion of each sampling event, sample locations were marked with a labeled stake to permit future location identification.

2.1.5 Sample Designation

Each soil sample was assigned a unique 8 character alpha-numeric designation to permit accurate sample documentation and tracking. The first two letters of the designation indicate the source area of the sample. The following designations apply: Lagoon Area-LA; Scraped Area-SA; Drainage Swales-DS. The location designation is followed by a two-digit number identifying the specific sampling location, for example samples from the Lagoon Area were sequentially identified as LA-01, LA-02, LA-03, etc, (location numbers corresponding to grid sampling points were predetermined prior to beginning the field work). An additional four digits at the end of the character string indicate the depth range over which the sample was taken. The full sample designation LA-01-04-08, for example, corresponds to the sample taken from Lagoon Area sampling point number 1, at a depth range of 4-8 feet.

2.1.6 Immunoassay Field Screening

Field screening using an immunoassay (IA)-based field test for detecting PAHs was conducted on soil samples from the grid points outside the initial perimeter for the sampling area. The goal of this analysis was to screen soils outside the perimeter to estimate whether cPAH levels were above or below the 44.7mg/kg action level. Confirmation split samples from final perimeter samples were sent to the ABB-ES laboratory for analysis.

Since IA testing measured only total PAHs and has a lower extraction efficiency than standard laboratory analysis, a conservative IA action level was developed before the field program was implemented. Before mobilizing, available samples of OU1 soil were split and analyzed by GC (modified Method 8100) and IA. Based on these comparative results, the following bases were developed to estimate the IA kit action level for the field sampling program:

- the concentration of cPAHs from GC analyses of OU1 soils were approximately 35-60% of the total PAH concentration in soil (to assure a conservative (low) field target, 60% was used to calculate the target);

- the percent recovery of total PAHs using the IA kit was approximately 30%.

Therefore the following calculation was used to develop the IA kit action level:

$$\text{IA kit action level} = \frac{\text{target cPAH concentration}}{60\%\ \text{cPAH/PAH ratio}} \times 30\%\ \text{PAH recovery by IA kit}$$

$$= \frac{44.7\ \text{mg/kg}}{0.6} \times 0.3\ \% = \quad 22.4\ \text{mg/kg total PAH}$$

Based on this evaluation, the conservative IA action level was established to be 20 mg/kg total PAH, meaning any sample with an IA field detected result of 20 mg/kg total PAH or greater was considered above the 44.7 mg/kg cPAH action level and indicated further expansion of the perimeter of the grid.

2.2 FIELD OBSERVATIONS

2.2.1 Lagoon Area

2.2.1.1 Soil Types and Visual Indications of Contamination

Soil borings in the Lagoon Area were conducted in 4-foot intervals at even-numbered grid points and at 2-foot intervals at odd-numbered grid points. The following soil descriptions in Table 2-1 are general visual observations of the soil conditions from the Lagoon Area boring log record sheets (Appendix B).

Table 2-1: General Soil Visual Observations-Lagoon Area

Depth (feet bgs)	Visual Observations
0 - 4	Primarily yellow-brown, silt and clay, usually overlain by black cinders. Frequent observations of fill material such as brick/concrete fragments and sand/gravel. Observations of tar common at these depths.
4 - 8	Primarily yellow-brown, stiff, silty clay often mixed with fill and black cinders. Occasional natural organic matter observed (i.e. twigs, roots). Some tar observed.
8 - 12	Primarily silty clay and clay, mixed with very fine sand. Soil of varying colors with yellow-brown coloration common. Refusal at 8 to 11 feet in some borings. One observation of possible tar at these depths was seen in LA-26.

Visual and olfactory evaluations of samples were recorded. In order to more effectively delineate the vertical extent of contamination, surficial samples that appeared to be "obviously" contaminated by tar were not analyzed. Only two of the three soil samples taken at a given sampling location were analyzed, therefore if the surface sample appeared obviously contaminated the two lower samples were analyzed in an effort to define the maximum depth of contamination.

2.2.1.2 Lagoon Area Grid Expansion

As stated in the Workplan, the borings on the perimeter of the sampling grid were conducted first. If the perimeter sample analytical results indicated that cPAH contamination existed along the perimeter of the grid, additional grid sampling points were added beyond the original grid perimeter. Some samples along the northeast, south, and west perimeter of the original Lagoon Area grid were found by the ABB-ES Wakefield laboratory to be above the action level (44.7 mg/kg at the time) and as a result the sampling grid was extended in these directions. Field screening using an immunoassay-based field test for estimating cPAHs was conducted on soil samples from the new grid points outside the initial grid perimeter. These field test results were used to determine whether the lateral limit of the cPAH contamination had been found. When the limit of the contamination had been established based on immunoassay field screening, soil samples from clean perimeter locations were taken for analysis by the ABB-ES Wakefield Laboratory.

A thirty foot extension of the Lagoon Area grid in selected locations along the northeast perimeter was conducted. Analytical results from these split samples confirmed the IA results and showed cPAH concentrations below the action level at all new sampling points on the northeast perimeter (LA-57, -102, -56, -67). Expansion of the grid to the south and west revealed visual indications (tar globules) of, and immunoassay results suggesting, extensive contamination beyond the original grid perimeter. This area of contamination was not expected based on the results of previous work done at the site (Weston, 1988 RI/FS Report). As a result of this contamination, the grid was expanded 150 feet (5 times 30 -foot grid) to the south and approximately 210 feet (7 times 30-foot) to the west. The western corner of the grid was extended until results below action levels were found at LA-94, -97, -98 and -103. The southwestern edge of the grid was expanded until results below action levels were found at LA- 86, -87, -88, and -89. The final Lagoon Area grid contained 103 sampling locations and measured approximately 330 by 380 feet (Figure 2-6).

2.2.1.3 Immunoassay Results-Lagoon Area

Field screening using an immunoassay (IA)-based field test (Millipore EnviroGard, EPA Method 4035) for detecting PAHs was conducted on soil samples from the new grid points outside the initial grid perimeter for the Lagoon Area.

Forty-eight of the Lagoon Area expanded grid sampling locations were analyzed using the IA test kits. Of the 48 samples analyzed by IA, 31 samples were also analyzed for cPAH by the ABB-ES Wakefield laboratory for confirmation. Those results which were not confirmed in the ABB-ES laboratory were sample locations from which the grid was expanded further due to visual observations of tar, so that these locations did not represent perimeter samples. The summarized results of the ABB-ES laboratory confirmation of the IA field analyses are presented in Table 2-2. The detailed results from the field IA screening are presented in Table 2-3.

Table 2-2: Lagoon Area Immunoassay and Confirmation Summary

		Immunoassay (IA) Result	
		Clean	Contaminated Above Target (20 mg/kg PAH)
ABB-ES Laboratory Result	Clean	25	1(false positive)
	Contaminated Above Target (44.7 mg/kg cPAH)	1 (false negative)	4

Of the 31 samples analyzed in the ABB-ES laboratory, there was agreement on the absence of contamination above the cPAH target (44.7 mg/kg at the time) in 25 samples and agreement on the presence of contamination above the target in 4 samples. In one case, (LA-65-02-04), a false positive result was detected by the IA, and the grid was expanded. Additional contamination was detected in the grid points expanded beyond LA-65. In one case, (LA-100-00-02), a false negative was detected by the IA. No visual or olfactory indications of contamination were noted in this sample by either ABB-ES field or laboratory personnel. Extension of the grid farther to the northwest from LA-100 would have placed the next sampling point in the wooded area adjacent to the road. Based on the IA result and the lack of visual or olfactory evidence of contamination, ABB-ES chose not to expand the grid from this point. Based on the subsequent ABB-ES analyses, it is possible that a small area of contamination exists between LA-100 and the road.

The primary purpose for developing the protocol for grid expansion was to find the "clean" perimeter in open, unvegetated areas. In some locations, the field crew, in consultation with project staff in Wakefield, made the judgment that a thirty-foot extension was not necessary. In these cases, if the grid were to be expanded, the next sampling location would be in undisturbed woodland with apparent native soil. In the Lagoon Area, in addition to LA-100, the following locations were not extended: LA-80, -96, -99, and 101. In addition, LA-81, at the southerly corner, was not extended because doing so would overlap with samples collected from Drainage Swale #1. Thus, of the 32 perimeter stations in the Lagoon Area, four have not been confirmed by laboratory analysis and these four stations may require slight expansion toward the woodland during excavation. All excavations during the remedial action will be sampled for analytical confirmation that sides and bottom are below the cPAH target concentration.

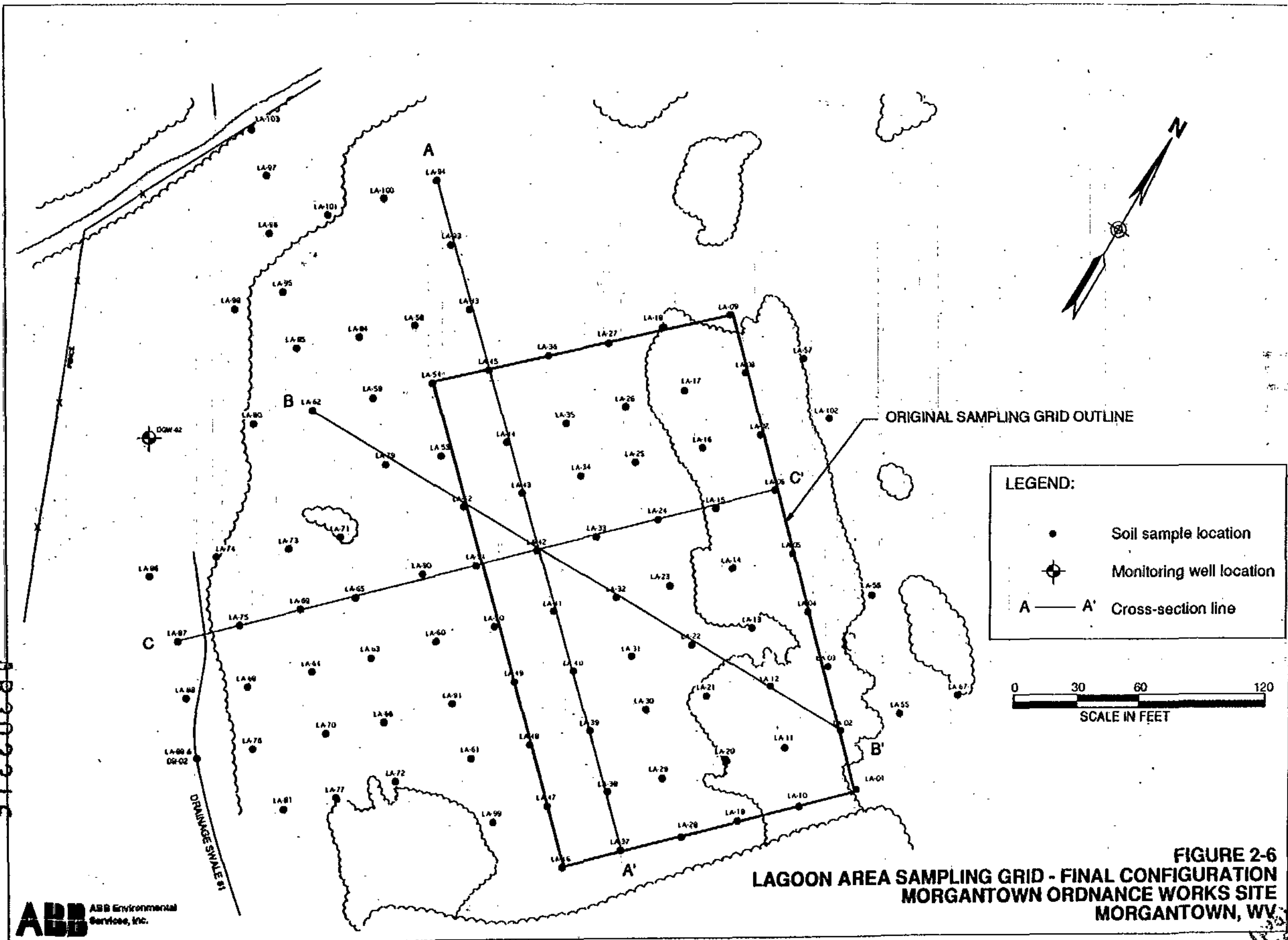

FIGURE 2-6
LAGOON AREA SAMPLING GRID - FINAL CONFIGURATION
MORGANTOWN ORDNANCE WORKS SITE
MORGANTOWN, WV

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Table 2-3 : Immunoassay Field Screening Results

Sample Id	Field Interpretation (mg/kg total PAH) (target = 20 mg/kg PAH)		Wakefield Lab cPAH result (mg/kg)	Comparison
DSI-12	~8	clean	<3.4	Agree
LA-55-00-02	> 20	expand	N/A	N/A
LA-55-02-04	< 2	clean	N/A	N/A
LA-56-02-04	~2	clean	< 2.7	Agree
LA-56-04-06	< 2	clean	<2.8	Agree
LA-57-02-04	< 2	clean	<3.17	Agree
LA-57-04-06	< 2	clean	<3.22	Agree
LA-58-02-04	< 2	clean	<3.63	Agree
LA-58-04-06	< 2	clean	<3.12	Agree
LA-59-02-04	< 2	clean	N/A	N/A
LA-59-04-06	> 20	expand	N/A	N/A
LA-60-02-04	< 2	clean	<3.02	Agree
LA-60-04-06	< 2	clean	<3.08	Agree
LA-61-02-04	< 2	clean	<2.91	Agree
LA-61-04-06	< 2	clean	<2.91	Agree
LA-62-00-02	> 20	expand	781	Agree
LA-62-02-04	< 2	clean	<3.22	Agree
LA-64-00-02	> 20	expand	N/A	N/A
LA-64-02-04	< 2	clean	<3.87	Agree
LA-65-00-02	> 20	expand	N/A	N/A
LA-65-02-04	~17	expand	<3.07	False Positive
LA-66-04-05	> 20	expand	N/A	N/A
LA-66-06-08	< 2	clean	N/A	N/A
LA-67-00-02	~11	clean	<3.41	Agree
LA-67-02-04	< 2	clean	<2.76	Agree
LA-68-00-04	> 20	expand	N/A	N/A
LA-68-05-06	> 20	expand	41	Agree
LA-69-00-02	> 20	expand	N/A	N/A
LA-69-02-04	< 2	clean	N/A	N/A
LA-70-00-02	> 20	expand	N/A	N/A
LA-70-02-04	< 2	clean	N/A	N/A
LA-71-00-02	> 20	expand	N/A	N/A
LA-71-02-04	~14	clean	N/A	N/A
LA-71-04-06	< 2	clean	N/A	N/A
LA-71-06-08	< 2	clean	N/A	N/A
LA-72-00-02	~3	clean	<2.94	Agree
LA-72-02-04	< 2	clean	<2.84	Agree
LA-81-00-02	> 20	expand	983	Agree
LA-84-04-06	< 2	clean	<6.13	Agree
LA-86-00-02	< 2	clean	<3.24	Agree
LA-87-00-02	< 2	clean	<3.07	Agree
LA-88-02-04	< 2	clean	<2.87	Agree
LA-89-00-02	< 2	clean	<3.15	Agree
LA-94-02-04	< 2	clean	<3.02	Agree
LA-97-00-02	< 2	clean	<3.32	Agree
LA-98-02-04	< 2	clean	<3.32	Agree
LA-99-00-02	> 20	expand	99	Agree
LA-100-00-02	< 2	clean	240	False Negative
LA-103-00-02	< 2	clean	<3.17	Agree
SA-25-00-02	< 2	clean	<3.04	Agree
SA-25-02-04	< 2	clean	N/A	N/A
SA-27-00-02	< 2	clean	<2.91	Agree
SA-27-02-04	< 2	clean	<2.85	Agree
SA-28-02-04	> 20	expand	N/A	N/A
SA-28-08-9.5	< 2	clean	<3.01	Agree
SA-33-00-02	< 2	clean	<2.87	Agree
SA-33-00-02D	< 2	clean	<2.87	Agree

N/A: sample not analyzed by Wakefield laboratory

Comparison of Table 2-3 with Figure 3-1 reveals some locations outside of the original grid that were not analyzed by IA in the field. The reasons for specific samples are listed below.

Samples	Reason for no IA Analysis
LA-77, -79, -80, -102	Wakefield laboratory results were available before field tests were done.
LA-101	Visible tar in sample.

2.2.2 Scraped Area

2.2.2.1 Soil Types and Visual Indications of Contamination

Soil borings in the Scraped Area were conducted in 4-foot intervals at odd-numbered grid points and at 2-foot intervals at even-numbered grid points. The following soil descriptions in Table 2-4 are general visual observations of soil conditions from the Scraped Area boring log record sheets (Appendix B).

Table 2-4: General Soil Visual Observations-Scraped Area

Depth (feet bgs)	Visual Observations
0 - 4	Primarily yellow-brown, stiff, silty clay, sometimes overlain by black cinders, occasionally contained small amounts of natural organic matter (i.e. twigs, roots). Visible tar present in several samples at these depths.
4 - 8	Primarily silty clay and clay of various colors (yellow, white, purple, brown), generally stiff with infrequent trace natural organic matter and cinders. Visible tar in some samples.
8 - 12	Primarily stiff to very stiff silty clay and clay, variable colors as above, with some concretions. Trace black grit/cinders in one sample. No observations of tar at this depth.

Visual and olfactory evaluations of samples were recorded. In order to more effectively delineate the vertical extent of contamination, surficial samples that appeared to be "obviously" contaminated by tar were not analyzed. Only two of the three soil samples taken at a given sampling location were analyzed, therefore if the surface sample appeared obviously contaminated the two lower samples were analyzed in an effort to define the maximum depth of contamination.

2.2.2.2 Scraped Area Grid Expansion

The original Scraped Area grid contained 24 sampling locations and measured 90 by 150 feet. As was done in the Lagoon Area, if the perimeter sample analytical results indicated that cPAH contamination existed along the perimeter of the grid, additional grid sampling points were added beyond the original grid. Some samples along the northeast and south perimeter of the original Scraped Area grid were found to be above the 44.7 mg/kg action level (action level at that time) and as a result the sampling grid was extended in these directions. Field screening using an immunoassay-based field test for estimating cPAHs was conducted on soil samples from the new grid points outside the initial grid perimeter. These field test results followed by laboratory confirmation were used to determine whether the lateral limit of the cPAH contamination had been found using the same procedures described for the Lagoon Area. The Scraped Area grid was expanded until results below action levels were found at SA- 25, -27, and -32. The final grid contained 36 sampling locations and measured approximately 150 by 350 feet (Figure 2-7).

In some locations on the perimeter of the Scraped Area, field judgments were made against grid expansion, based on the same logic as described for the Lagoon Area. These locations included SA-02, -30, -34, and -35. In addition, expansion beyond SA-31 and SA-36 was not conducted because these samples were collected to characterize a discrete pile of material less than approximately thirty feet wide. Thus, of the 18 grid perimeter stations in the Scraped Area, four have not been confirmed by laboratory analysis because the grid nodes were not extended into the surrounding woodland. Those four locations may require slight expansion toward the woodland during excavation. All excavations during the remedial action will be sampled for analytical confirmation that sides and bottom are below the cPAH target concentration.

2.2.2.3 Immunoassay Results-Scraped Area

Field screening using an immunoassay-based field test (Millipore EnviroGard, EPA Method 4035) for detecting cPAHs was conducted on soil samples from the new grid points outside the initial Scraped Area perimeter.

Eight of the Scraped Area expanded grid sampling locations were analyzed using the IA test kits. In some instances the grid was expanded without IA analysis because samples appeared "obviously contaminated" with tar upon visual inspection of the soil boring. Of the 8 samples analyzed by IA, 6 samples were also analyzed for cPAH by the ABB-ES Wakefield laboratory Those results which were not confirmed in the ABB-ES laboratory were sample locations from which the grid was expanded further, or in the case of SA-25-02-04, a location where the 00-02' sample was confirmed clean. The summarized results of the ABB-ES laboratory confirmation of the IA field analyses are presented in Table 2-5. The detailed results from this screening are presented in Table 2-3.

Of the 6 samples confirmed, there was agreement on the absence of contamination above the cPAH target in all 6.

Table 2-5: Scraped Area Immunoassay and Confirmation Summary

		Immunoassay (IA) Result	
		Clean	Contaminated Above Target (20 mg/kg PAH)
ABB-ES Laboratory Result	Clean	6	0
	Contaminated Above Target (44.7 mg/kg cPAH)	0	0

Comparison of Table 2-3 with Figure 3-5 reveals some locations outside of the original grid that were not analyzed by IA in the field. The reasons for specific samples are listed below.

Samples	**Reason for no IA Analysis**
SA-02	Wakefield laboratory results were available before field tests were done.
SA-34, -35	Visible tar in sample.
SA-26, -29, -30	Visual and olfactory evidence plus location of these points in a clearly defined depression.
SA-31, -36	Samples were collected to characterize a discrete pile, not as a grid extension.

2.2.3 Drainage Swales

2.2.3.1 Soil Types and Visual Indications of Contamination

Drainage Swale samples were taken from the top 6-inches of soils at 100-foot intervals in each of the three Drainage Swales. Field evaluated sample parameters are presented in Table 2-6. In general, Drainage Swale samples were silt and sand soil types. Pooled standing water depth in several sample locations was measured to a maximum of 3 inches in parts of Drainage Swales #1 and #2. The pH of the standing water in Drainage Swales #2 exhibited an apparently lower pH at sampling locations DS2-06 through DS2-10, compared to the locations upstream. The reason for

Table 2-6 : Field-evaluation of Drainage Swale Sample Parameters

Sample ID	Temp. (deg. C)	pH	eH (mV)	Conductivity (umhos/cm)	Soil Type (visual interpretation)	Water Depth (feet)	Munsell Color Code*	Munsell Color Description
Swale #1								
DS1-01	5.5	5.8	133	65	Fine Silt	0.25	HUE 10 yr. 5/4	Yellowish Brown
DS1-02	N/A	N/A	N/A	N/A	Silt	0	HUE 10 yr. 3/3	Dark Brown
DS1-03	7.2	6.0	150	85	Silty	0.01	HUE 10 yr. 5/6	Yellowish Brown
DS1-04	5.8	6.0	150	65	Silty	0.1	HUE 10 yr. 5/4	Yellowish Brown
DS1-05	6.0	5.9	115	64	Sand.	0.25	HUE 10 yr. 4/4	Dark Yellow/Brown
DS1-06	6.3	5.8	131	95	Fine Silt	0.25	HUE 10 yr. 4/3	Dark Brown
DS1-07	5.7	6.6	53	73	Silty Fine Sand	0.25	HUE 10 yr. 4/3	Dark Brown
DS1-08	6.4	5.6	140	73	Silty Sand	0.25	HUE 10 yr. 4/6	Dark Yellow/Brown
DS1-09	5.5	5.7	250	69	Silty Fine Sand	0.25	HUE 10 yr. 5/4	Yellowish Brown
DS1-10	5.7	5.6	155	71	Silty Fine Sand	0.25	HUE 10 yr. 5/4	Yellowish Brown
DS1-11	5.7	5.6	115	68	Fine Sand	0.5	HUE 10 yr. 5/3	Brown
DS1-12	4.4	5.6	190	63	Med. Sand	0.5	HUE 10 yr. 4/3	Dark Brown
Swale #2								
DS2-01	2.4	5.9	215	96	Coarse Sand	0.25	HUE 2.5 yr. 5/4	Reddish Brown
DS2-02	2.2	5.6	282	103	Coarse Sand Cobbles	0.25	HUE 2.5 yr. 5/4	Reddish Brown
DS2-03	1.7	5.4	219	101	Med. Sand, some Cobbles	0.3	HUE 2.5 yr. 5/4	Reddish Brown
DS2-04	1.5	5.7	362	107	Medium Sand	0.25	HUE 2.5 yr. 5/3	Reddish Brown
DS2-05	1.9	5.1	276	105	Coarse sand w/cobbles	0.3	HUE 2.5 yr. 6/4	Light Red-Brown
DS2-06	1.7	4.4	361	104	Sand	0.25	HUE 10 yr. 5/6	Yellowish Brown
DS2-07	1.7	4.2	288	164	Coarse Sand	0.4	HUE 7.5 yr. 4/4	Brown/Dark Brown
DS2-08	2.4	4.8	236	88	Coarse Sand Silt	0.01	HUE 7.5 yr. 4/4	Brown/Dark Brown
DS2-09	2.4	4.5	304	87	Sandy Silt	0.02	HUE 7.5 yr. 4/4	Brown/Dark Brown
DS2-10	2.5	4.8	339	86	Silty Sand	0.03	HUE 7.5 yr. 4/4	Brown/Dark Brown
Swale #3								
DS3-01	3.8	6.5	88	934	Silty Sand	0.03	HUE 7.5 yr. 4/6	Strong Brown
DS3-02	3.4	6.7	27	477	Silty Sand	0.07	HUE 10 yr. 4/2	Dark Gray-Brown
DS3-03	2.8	7.9	-6	371	Sandy Silt	0.02	HUE 10 yr. 4/2	Dark Gray-Brown
DS3-04	2.8	6.7	64	339	Sandy Silt	0.03	HUE 10 yr. 4/2	Dark Gray-Brown
DS3-05	2.8	6.7	68	324	Sand w/Black Speckles	0.14	HUE 10 yr. 4/2	Dark Gray-Brown
DS3-06	2.9	6.8	64	301	Silt	0.02	HUE 7.5 yr. 3/3	Dark Brown

*Munsell color codes are composed of three elements; hue, value , and chroma. The color code is always written with the components in this order. Hue refers to the dominant spectral or "rainbow color" of the soil (red, yellow, blue, green). An example of hue is 10 yr, which corresponds to the most yellow of the yellow-red color group; as the amount of yellow present decreases, the number decreases. Value refers to the relative blackness or whiteness, the amount of reflected light. The notation for value is a number from 0 (absolute black) to 10 (absolute white). Chroma refers to the purity of the "color", purity increases with decreasing grayness. The notation for chroma consists of numbers beginning with 0 for neutrals grays and increase to a maximum of 20.
(quoted in part from Munsell Soil Color Charts, Kollmorgen Instrument Corp., New York, 1990)

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the apparent pH reduction in Drainage Swale #2 is not known.

Drainage Swales #2 and 3 exhibited no visible tar or other evidence of contamination, with the exception of sample point DS3-02, where a sheen developed on the water surface when disturbed for sampling. This sheen dissipated in less than one minute.

In the upper reaches of Drainage Swale #1, tar is visible on the (dry) land surface between sample stations DS1-03 and DS1-04. No defined channel exists in this area and ABB-ES has never observed water flowing here; it is simply a broad, low area. The tar in this area appears as a thin crust on the ground surface. No samples deeper than 6" below ground surface (bgs) contained detectable cPAHs in this area.

2.2.3.2 Grid Expansion - Drainage Swale #1

Due to the observation of visual indications of contamination and analytical results indicating high cPAH concentrations in Drainage Swale #1 at sample stations DS1-03 and DS1-04, six additional sampling points were chosen for the area between DS1-03 and DS1-04. These six samples were taken from a grid area set up between DS1-03 and DS1-4. The depth of sampling in this grid area varied from 6 inches to two feet, depending on the visual appearance of the soil in a given sampling location.

2.2.3.3 Immunoassay Results-Drainage Swales

The farthest downstream sample from DS#1 was analyzed using the IA test kit. Both the test kit and the ABB-ES Laboratory analysis indicated that this sample had non-detectable levels of cPAHs.

2.2.4 Areas of Concern

The areas discussed in the following two sections are areas of concern which were identified in site walkovers during late 1995. Based on visual observations of the ground surface and topography, subsurface soil samples were taken in these areas.

2.2.4.1 Clearings to east & north of Scraped Area

To the east of the Scraped Area, a small clearing with access for a vehicle was noted. This area is the location of sample point SA -25 (Figure 2-7). To the north, areas of disturbed topography, absence of vegetation, and apparent waste materials on the land surface were observed during a site tour; sample point SA-33 corresponds to this area (Figure 2-7).

2.2.4.2 Mound

To the southeast of the Scraped Area, a mound approximately the size of an automobile was observed as an apparent unnatural topographic feature among the trees. Soil in this area was sampled. Sampling point SA-32 was conducted in this area (Figure 2-7).

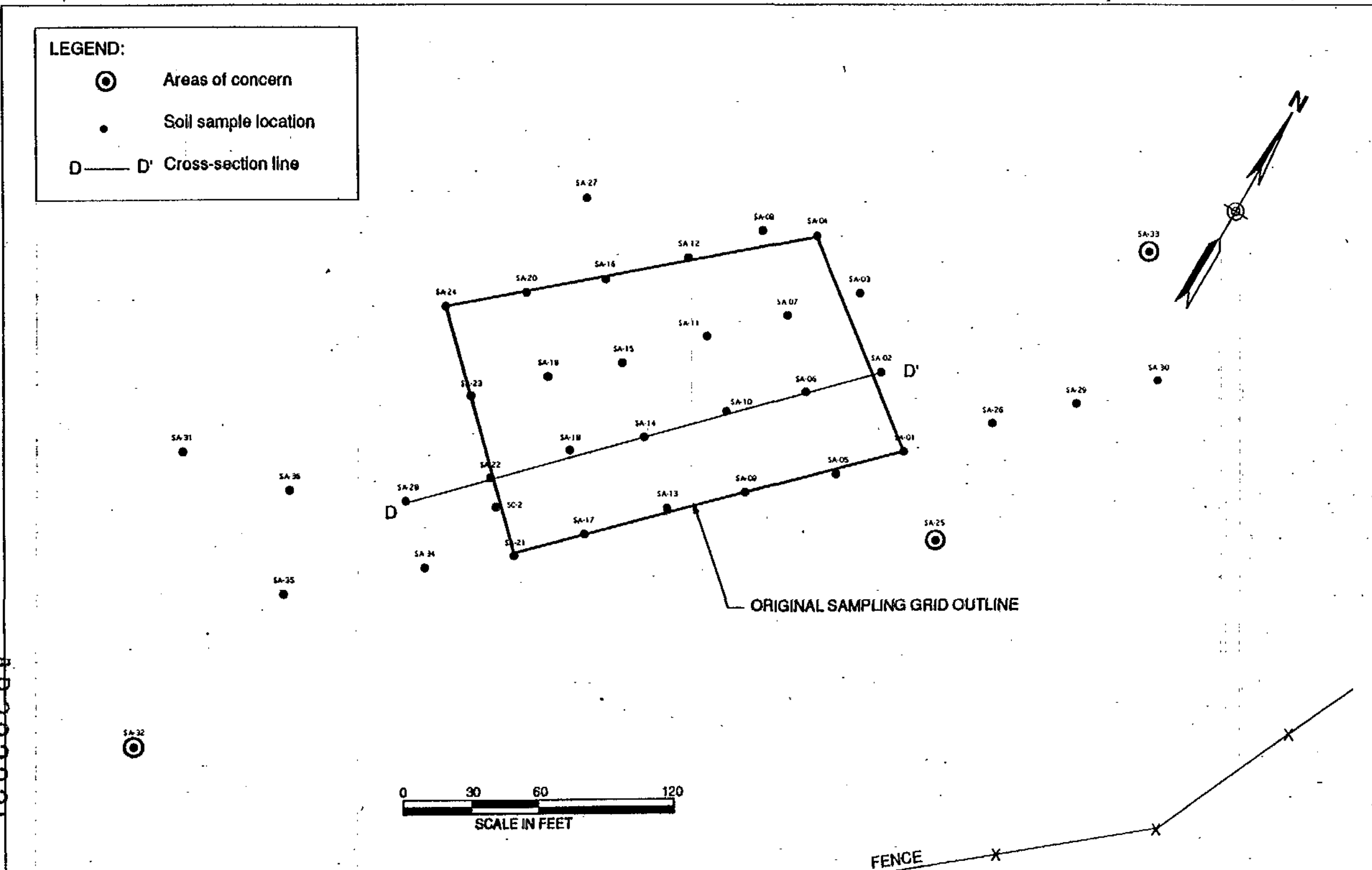

Figure derived from Law Engineering and Environmental Services survey 3/8/96.

ABB Environmental Services, Inc.

6778-11G

FIGURE 2-7
SCRAPED AREA SAMPLING GRID - FINAL CONFIGURATION
MORGANTOWN ORDNANCE WORKS SITE
MORGANTOWN, WV

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3.0 LABORATORY ANALYSIS/RESULTS

Two soil intervals from each of the Lagoon Area and Scraped Area Geoprobe borings and all Drainage Swale samples were selected for laboratory analysis by the ABB-ES Wakefield Laboratory. These soil samples were analyzed for cPAHs, using Modified EPA Method 8100. Samples were sent to external laboratories for metals analysis and confirmatory duplicate cPAH analysis.

3.1 External Laboratory

The initial plan for sample analyses for the Pre-design Sampling task specified that metals and confirmatory cPAH analyses would be conducted by ES&E. The external laboratory's protocols, procedures, and results were audited by a representative from Law Environmental. This audit revealed that the metals analyses were conducted by ES&E in an acceptable manner. However, the confirmatory cPAH analyses performed by ES&E were not conducted in a way that was consistent with Workplan specifications and generally accepted standards for laboratory practices.

As a result of this less than satisfactory evaluation of the ES&E confirmatory cPAH analyses and resulting data, it was determined that those sampling points, from which confirmatory cPAH samples were taken, should be resampled and reanalyzed by both ABB-ES and an external confirmatory laboratory. In an effort meet Workplan specifications and to avoid additional confirmatory laboratory quality related issues, a second laboratory, IEA, was chosen to perform the second round of confirmatory cPAH analyses. The second round of confirmatory sampling was conducted during the first week in May 1996. Performance auditing of IEA laboratory activities was provided by a representative from Law Environmental.

3.2 Metals

Sampling for the metal contaminants of concern (arsenic, cadmium, lead and copper) was conducted using the Geoprobe at a depth of 8-10 feet, at a total of ten locations (ten samples and one field duplicate) in the two areas that were suspected to have elevated soil metals concentrations based on previous analytical results for the Site (Weston 1988). These two areas were the area of the former soil boring 9 (BOR-9, Weston, 1988), the only Lagoon Area sample with metal concentrations above the ROD target concentration and the area of the former Scraped Area test pit 2 (SCA-02, Weston, 1988), the only Scraped Area sample with metal concentrations potentially above the ROD target concentration (duplicate sample results were well below ROD targets). One sample was taken at the former location of BOR-09, as closely as could be determined. The remaining four Lagoon Area samples were taken at equally-spaced points (90° apart) at a 10-foot radius from the inferred location of BOR-09 (Figure 2-3). Similarly, one sample was taken at the former location of SCA-02, as

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closely as could be determined. The remaining four Scraped Area samples were taken at equally-spaced points at a 10-foot radius from the inferred location of SCA-02 (SC-2 on Figure 2-4).

Metals analysis was conducted by ES&E (Gainesville, FL). Analyses for arsenic were conducted using SW-846 Method 7060 while the remaining metals were analyzed by SW-846 Method 6010. Results from these ten analyses indicate that no soil was identified with metals concentrations above the ROD-specified action levels. The metals analytical results are presented in Table 3-1. The data report package is included in Appendix C. Although no soils showed metals concentrations above action levels, concentrations above background appeared in some samples (e.g. lead in SC-B2-08-10 and copper in SA-22-08-10). The possibility of undetected exceedances can not be ruled out.

Table 3-1: Lagoon and Scraped Area Metals Results

Sample ID Field	Lab	Arsenic	Action Level	Lead	Action Level	Cadmium	Action Level	Copper	Action Level
BR-B9-08-10	MABBS 1	0.684	88.8	19.1	500	<0.645	642	23.3	41,100
BR-D9-08-10	MABBS 2	2.5	88.8	19.3	500	<0.633	642	18.3	41,100
BR-C9-08-10	MABBS 3	6.47	88.8	28.2	500	<0.674	642	50.6	41,100
BR-E9-08-10	MABBS 4	1.95	88.8	14.2	500	<0.630	642	23.8	41,100
BR-E9-08-10 D	MABBS 6	0.482	88.8	<12.7	500	<0.636	642	19.9	41,100
BR-09-08-10	MABBS 5	2.59	88.8	22.2	500	<0.616	642	383	41,100
SC-D2-08-10	MABBS 7	31.2	88.8	168	500	<0.686	642	686	41,100
SC-C2-08-10	MABBS 8	8.68	88.8	57.9	500	<0.821	642	2,360	41,100
SC-B2-08-10	MABBS 9	8.90	88.8	428	500	2.21	642	634	41,100
SC-02-08-10	MABBS 10	5.71	88.8	24.6	500	<0.654	642	1,020	41,100
SA-22-08-10	MABBS 11	11.7	88.8	51.7	500	<0.683	642	12,100	41,100

- All results in mg/kg-dry
- Samples in the area of BOR-9 where assigned sample ids beginning with BR. Samples in the area of SCA-02 were assigned sample ids beginning with SC, with the exception of SA-22. SA-22 was collocated with the sample that would have been referred to as SC-E2.
- The Weston RI/FS (1988) reported nine samples from the vicinity of OU1 intended to define background metals concentrations. Average background concentrations for the four metals of concern were as follows: arsenic 9.1 mg/kg, cadmium 0.7 mg/kg, copper 16 mg/kg, and lead 26 mg/kg.

3.3 ABB-ES Wakefield Laboratory- cPAHs

A combined total of approximately 300 samples were analyzed for cPAH from the Lagoon Area, Scraped Area, and Drainage Swales at the ABB-ES Wakefield Laboratory using Modified USEPA Method 8100 as specified in the EPA-approved workplan. Soil samples at the laboratory were thoroughly mixed prior to sub-sampling from the jar for laboratory analysis, therefore the analytical results represent the average cPAH concentration in the sample jar. Samples were extracted using

USEPA Method 3550, this extraction technique involves shaking rather than sonication. A table of all the cPAH analytical results generated at the ABB-ES laboratory are presented in Appendix C. A summary of those sample results that were above the EPA-specified action level of 78 mg/kg are presented in Table 3-2.

It is important to note that some samples which exhibited "obvious" olfactory and visual contamination were not analyzed. Two of the three samples taken from any single sample boring were chosen for analysis. In an effort to define the maximum depth of contamination, obviously contaminated surficial samples sometimes were not chosen for analysis.

3.3.1 Lagoon Area

The ABB-ES laboratory found that 39 samples out of a total of 179 samples analyzed from the Lagoon Area contained cPAH concentrations above the existing action level of 78 mg/kg. The majority of these detections were located at a depth of 0-4 feet, and were randomly distributed throughout the Lagoon Area (Figure 3-1). Several detections above the action level were found to the south and southwest, outside of the original sampling grid. This area of contamination was not expected based on previous work conducted at the site (Weston RI/FS, 1988). Figure 3-1 shows results expressed as total cPAHs and as benzo(a)pyrene (B(a)P) equivalents. B(a)P equivalents form the basis for the risk assessment, by expressing the carcinogenic potential of the cPAHs, weighted by their individual potencies.

Although most detections of cPAHs in the Lagoon Area were in the surficial soils, there were some samples (LA-42, 43, 44, and 53) in the western corner of the original sampling grid where medium to high concentrations of cPAHs were identified in the 8-12 foot sampling depth interval.

In this small area of four adjacent borings, excavation to a depth greater than 12 feet may be required. Three profiles of Lagoon Area contamination are presented in Figure 3.2, 3.3, and 3.4. These profiles illustrate the random distribution of cPAH contamination in the Lagoon Area.

3.3.2 Scraped Area

The ABB-ES laboratory found that 12 samples out of a total of 77 samples analyzed from the Scraped Area contained cPAH concentrations above the existing action level of 44.7 mg/kg. All of these detections were located in the upper 4 feet of soil, and were located in the northeast and south of the sampling grid, primarily outside of the original grid (Figure 3-5). Figure 3-5 shows results expressed as total cPAHs and as B(a)P equivalents.

One profile of Scraped Area contamination is presented in Figure 3.6. This profile illustrates the random distribution of cPAH contamination, primarily in discrete pockets north and south of the original sampling grid in the Scraped Area.

Table 3-2: ABB-ES cPAH Analytical Results (above detection limit)

ND-78 mg/Kg

Drainage Swales			
Sample ID	Date Sampled	Lab ID	Total cPAH (mg/Kg)
DS2-9	09-Feb-96	Q222774E	3
DS2-10	09-Feb-96	Q22246F1	4
DS1-02	10-Feb-96	Q2244A65	5.7
DS1-16-01-02	14-Feb-96	Q22A3EAC	6.7
DS1-11	10-Feb-96	Q224CF32	7.8
DS1-11D	10-Feb-96	Q224DBE2	25
DS1-09	10-Feb-96	Q224B5D6	9.4
DS2-08	09-Feb-96	Q2225D98	11
DS3-06	09-Feb-96	Q221EC8E	15
DS2-01	10-Feb-96	Q2239277	20
DS3-04	09-Feb-96	Q222067A	26
DS3-05	09-Feb-96	Q221F985	29
DS2-04	10-Feb-96	Q223B8B0	47
DS2-07	10-Feb-96	Q223EC02	50
DS2-03	10-Feb-96	Q223ABEF	50
DS1-05	10-Feb-96	Q2248309	57
DS2-07	10-Feb-96	Q223DF25	57
DS2-02	10-Feb-96	Q2239F31	65
DS3-03	09-Feb-96	Q2221366	67
DS1-10	10-Feb-96	Q224C284	70

Lagoon Area			
Sample ID	Date Sampled	Lab ID	Total cPAH (mg/Kg)
LA-34-00-04D	9-Feb-96	Q222DF28	3.2
LA-83-04-06	16-Feb-96	Q22EE6CA	3.5
LA-46-03-04D	2-Feb-96	Q219FBF9	4.9
LA-102-00-02	16-Feb-96	Q22FE13B	5
LA-45-04-06	13-Feb-96	Q2294D63	5.4
LA-29-06-08	11-Feb-96	Q2272816	5.5
LA-46-09-10	2-Feb-96	Q21A150D	7.1
LA-22-04-08	7-Feb-96	Q21F1E76	7.3
LA-23-02-04	13-Feb-96	Q2286D3A	15
LA-17-00-02	15-Feb-96	Q22BF675	18
LA-73-02-04	15-Feb-95	Q22CE12A	21
LA-101-02-04	16-Feb-96	Q22E6343	24
LA-27-00-02	15-Feb-96	Q22EA5DF	36
LA-68-05-06	14-Feb-96	Q22EBFFB	41
LA-48-02-03	3-Feb-96	Q21BC639	65
LA-19-00-02	11-Feb-96	Q225020C	71
LA-73-00-02	15-Feb-96	Q22CD461	73

Scraped Area			
Sample ID	Date Sampled	Lab ID	Total cPAH (mg/Kg)
SA-35-02-04	14-Feb-96	Q22AD6CD	3.7
SA-20-02-04	11-Feb-96	Q2271B42	7.9
SA-34-00-04	14-Feb-96	Q22ABD32	16
SA-23-00-02	11-Feb-96	Q22679FD	22
SA-05-00-02	11-Feb-96	Q225886C	26
SA-11-00-04	6-Feb-96	Q21DD7DO	36

78-200 mg/Kg

Drainage Swales			
Sample ID	Date Sampled	Lab ID	Total cPAH (mg/Kg)
DS1-01	10-Feb-96	Q2243D9B	140

Lagoon Area			
Sample ID	Date Sampled	Lab ID	Total cPAH (mg/Kg)
LA-50-00-04	3-Feb-96	Q21BACD4	91
LA-07-00-02	15-Feb-96	Q22D26BF	94
LA-02-00-04	2-Feb-96	Q2193D05	95
LA-99-00-02	16-Feb-96	Q22E490A	99
LA-38-05-06	3-Feb-96	Q21BDFB8	110
LA-31-04-06	13-Feb-96	Q228467D	160
LA-31-04-06D	13-Feb-96	Q2285367	190
LA-47-00-02	11-Feb-96	Q2262C69	160
LA-43-06-08	15-Feb-96	Q22B4F11	170
LA-42-08-12	7-Feb-96	Q21FA21	170
LA-17-00-02D	15-Feb-96	[illegible]C0364	190

Scraped Area			
Sample ID	Date Sampled	Lab ID	Total cPAH (mg/Kg)
SA-31-00-02	13-Feb-96	Q22F6863	94
SC-02-00-04	5-Feb-96	Q21CD5EB	110
SA-16-00-04	6-Feb-96	Q21DBDD1	130

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Table 3-2: ABB-ES cPAH Analytical Results (above detection limit)

(Continued)

200-1000 mg/Kg

Drainage Swales			
Sample ID	Date Sampled	Lab ID	Total cPAH (mg/Kg)
DS3-02	09-Feb-96	Q222204D	220
DS1-08	10-Feb-96	Q224A926	260
DS1-05	10-Feb-96	Q2248FBA	270
DS1-07	10-Feb-96	Q2249C75	290

Lagoon Area			
Sample ID	Date Sampled	Lab ID	Total cPAH (mg/Kg)
LA-100-00-02	16-Feb-96	Q22E561E	240
LA-30-00-02	4-Feb-96	Q21C6DA3	260
LA-08-00-04	3-Feb-96	Q21AFA22	260
LA-44-04-08	7-Feb-96	Q21FBBFF	310
LA-25-02-04	16-Feb-96	Q22E97B8	410
LA-77-00-02	15-Feb-96	Q22C512E	430
LA-80-00-02	15-Feb-96	Q22D87F7	460
LA-76-00-02	15-Feb-96	Q22C36F4	550
LA-47-00-03	15-Feb-96	Q22C84D9	600
LA-44-04-12	7-Feb-96	Q21FC9B6	680
LA-62-00-02	12-Feb-96	Q229B6AF	780
LA-81-00-02	15-Feb-96	Q22D761C	980

Scraped Area			
Sample ID	Date Sampled	Lab ID	Total cPAH (mg/Kg)
SA-26-02-04	13-Feb-96	Q22F343E	250
SA-30-00-02	15-Feb-96	Q22C9FDF	330
SA-29-03-04	16-Feb-96	Q22F4E01	350
SA-30-02-08	15-Feb-96	Q22CACA1	450
SA-01-00-04	6-Feb-96	Q21E3F91	810

>1000 mg/Kg

Drainage Swales			
Sample ID	Date Sampled	Lab ID	Total cPAH (mg/Kg)
DS1-04	10-Feb-96	Q2247474	1700
DS1-13-00-0.5	14-Feb-96	Q229D176	1700
DS1-03	10-Feb-96	Q224572A	2100
DS1-03D	10-Feb-96	Q224659C	2200
DS1-16-00-0.5	14-Feb-96	Q22AFAA	8300
DS1-14-00-0.5	14-Feb-96	Q2293ECFA	28000

Lagoon Area			
Sample ID	Date Sampled	Lab ID	Total cPAH (mg/Kg)
LA-51-02-04	13-Feb-96	Q2296764	1100
LA-53-04-08	13-Feb-96	Q227DAE6	1200
LA-96-00-02	16-Feb-96	Q22E20A1	1200
LA-49-02-04	11-Feb-96	Q226FF6D	1500
LA-53-08-10	13-Feb-96	Q227E98A	1500
LA-39-00-02	11-Feb-96	Q225355D	1900
LA-42-00-04D	7-Feb-96	Q21FA133	2800
LA-25-00-02	16-Feb-96	Q22E88DB	2500
LA-54-03-04	3-Feb-96	Q21B536F	3000
LA-49-00-02	11-Feb-96	Q226F05B	4400
LA-43-04-06	16-Feb-96	Q22B3ED4	5000
LA-40-00-03	4-Feb-96	Q21C876D	12000
LA-40-00-04 RE	5-Feb-96	Q220191E	13000
LA-75-00-02	15-Feb-96	Q22CB973	15000
LA-13-02-04	13-Feb-96	Q229307E	21000
LA-04-02-04	2-Feb-96	Q219562F	30000

Scraped Area			
Sample ID	Date Sampled	Lab ID	Total cPAH (mg/Kg)
SA-02-00-02	11-Feb-96	Q226C7FB	2000
SA-22-00-04	5-Feb-96	Q21CEFAE	3500
SA-18-02-04	13-Feb-96	Q228D473	19000
SA-36-00-02	14-Feb-96	Q22AF05A	36000

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Method = Modified EPA 8100, GC-FID

*Raw analytical results corrected to two significant figures

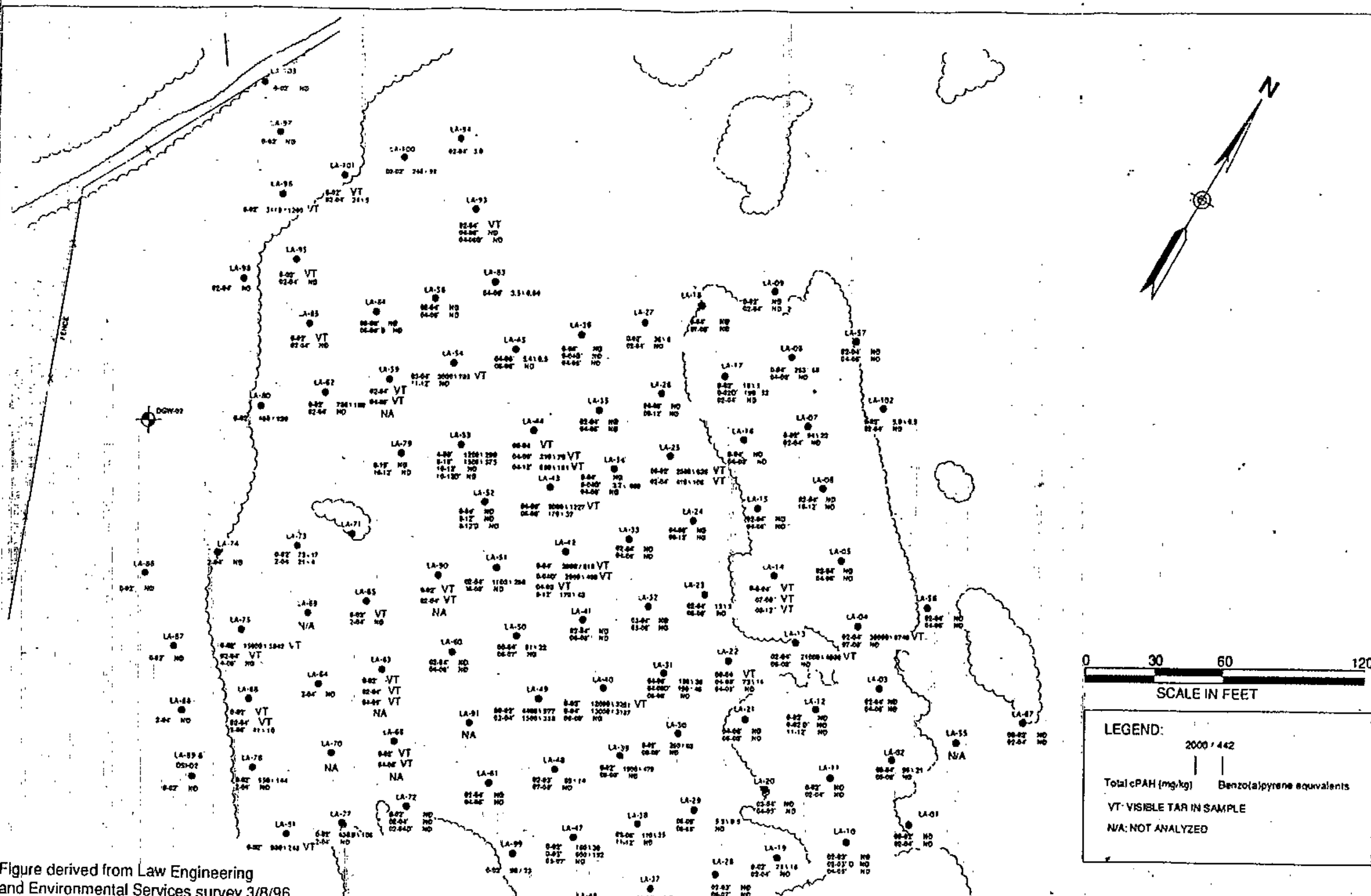

Figure derived from Law Engineering and Environmental Services survey 3/8/96.

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FIGURE 3-1
LAGOON AREA - ABB-ES cPAH RESULTS
MORGANTOWN ORDNANCE WORKS SITE
MORGANTOWN, WV

AR302330

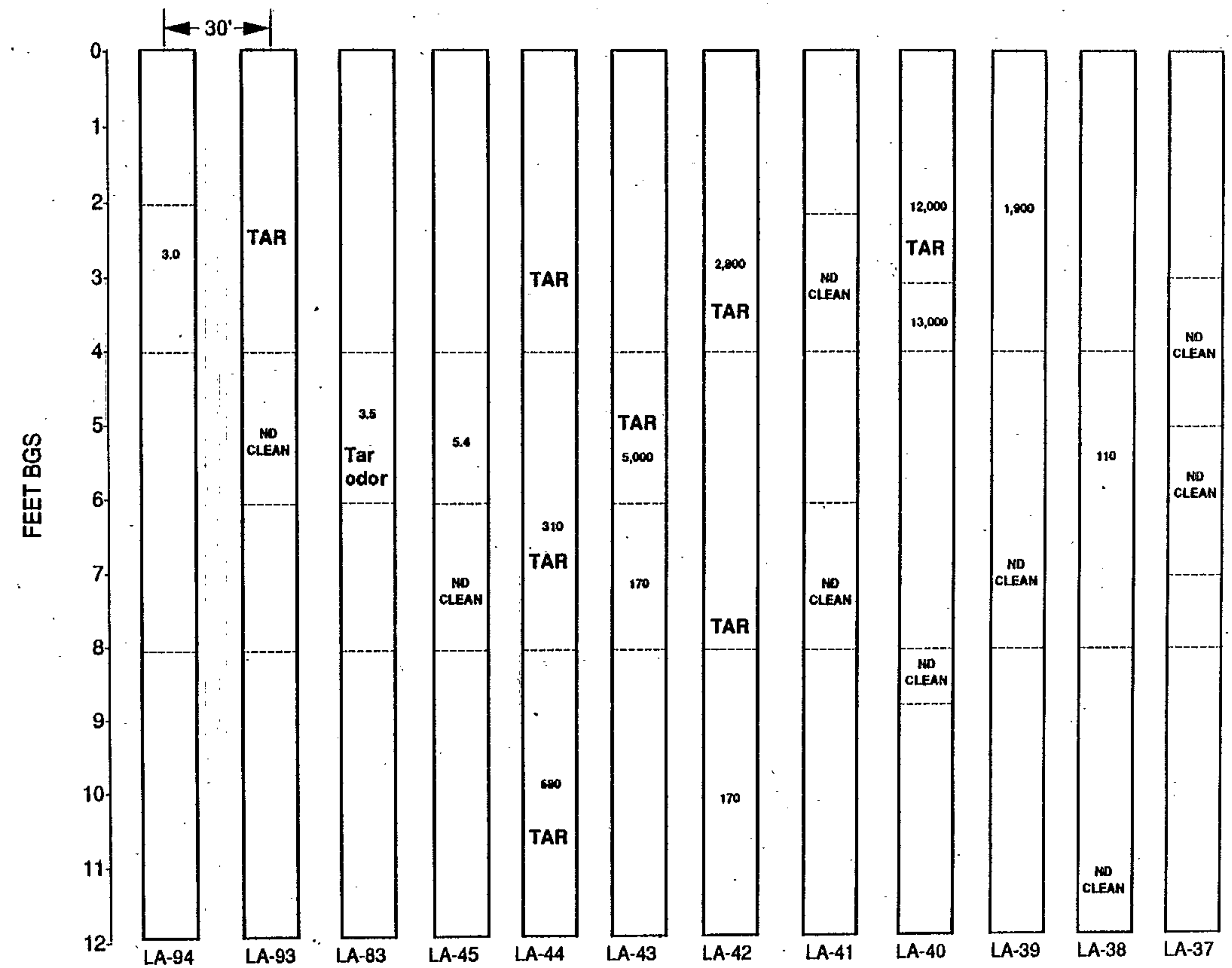

FIGURE 3-2
LAGOON AREA cPAH SOIL PROFILE A-A'
MORGANTOWN ORDNANCE WORKS SITE
MORGANTOWN, WV

ABB Environmental Services, Inc.

6778 11D

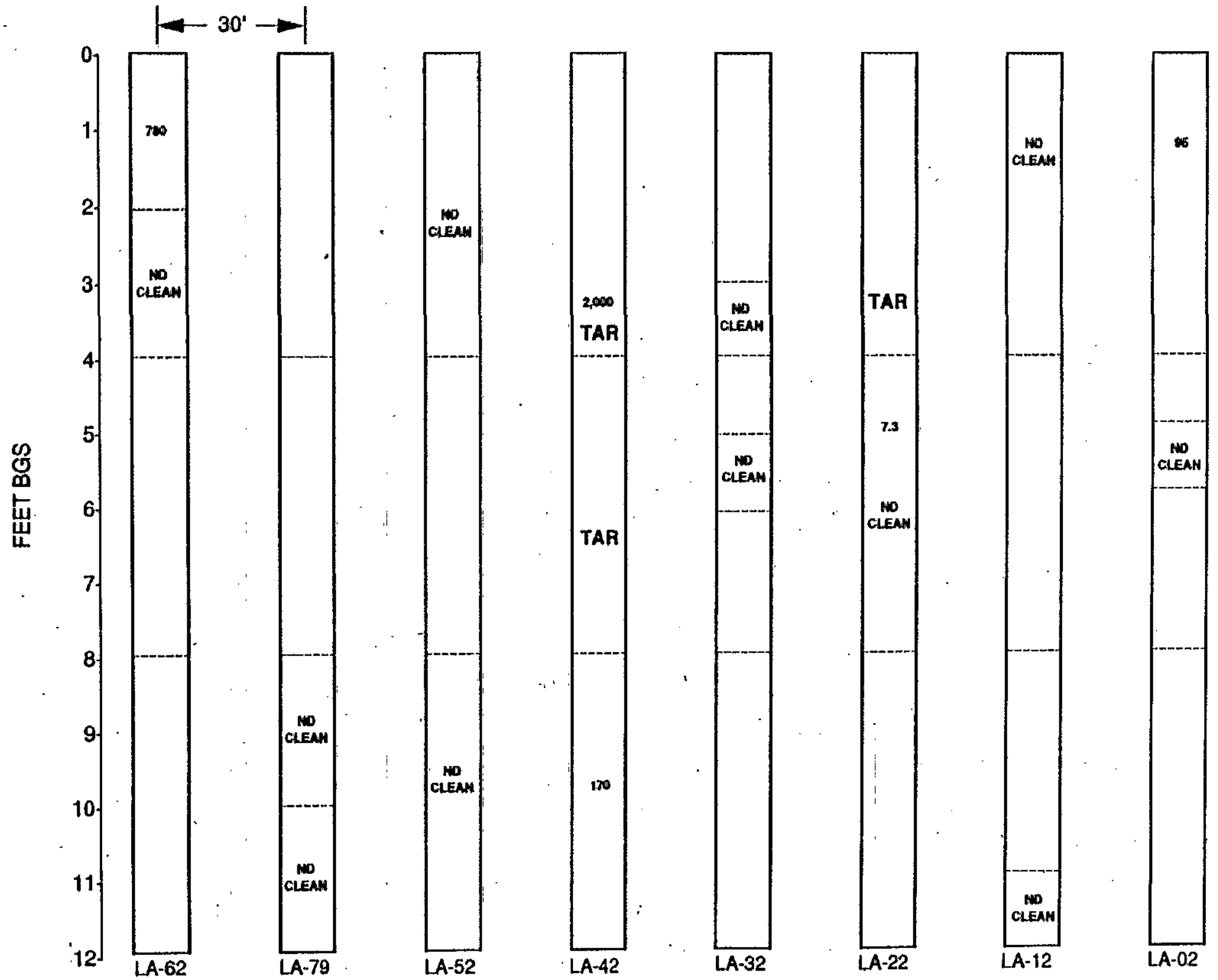

FIGURE 3-3
LAGOON AREA cPAH SOIL PROFILE B-B'
MORGANTOWN ORDNANCE WORKS SITE
MORGANTOWN, WV

ABB Environmental Services, Inc.

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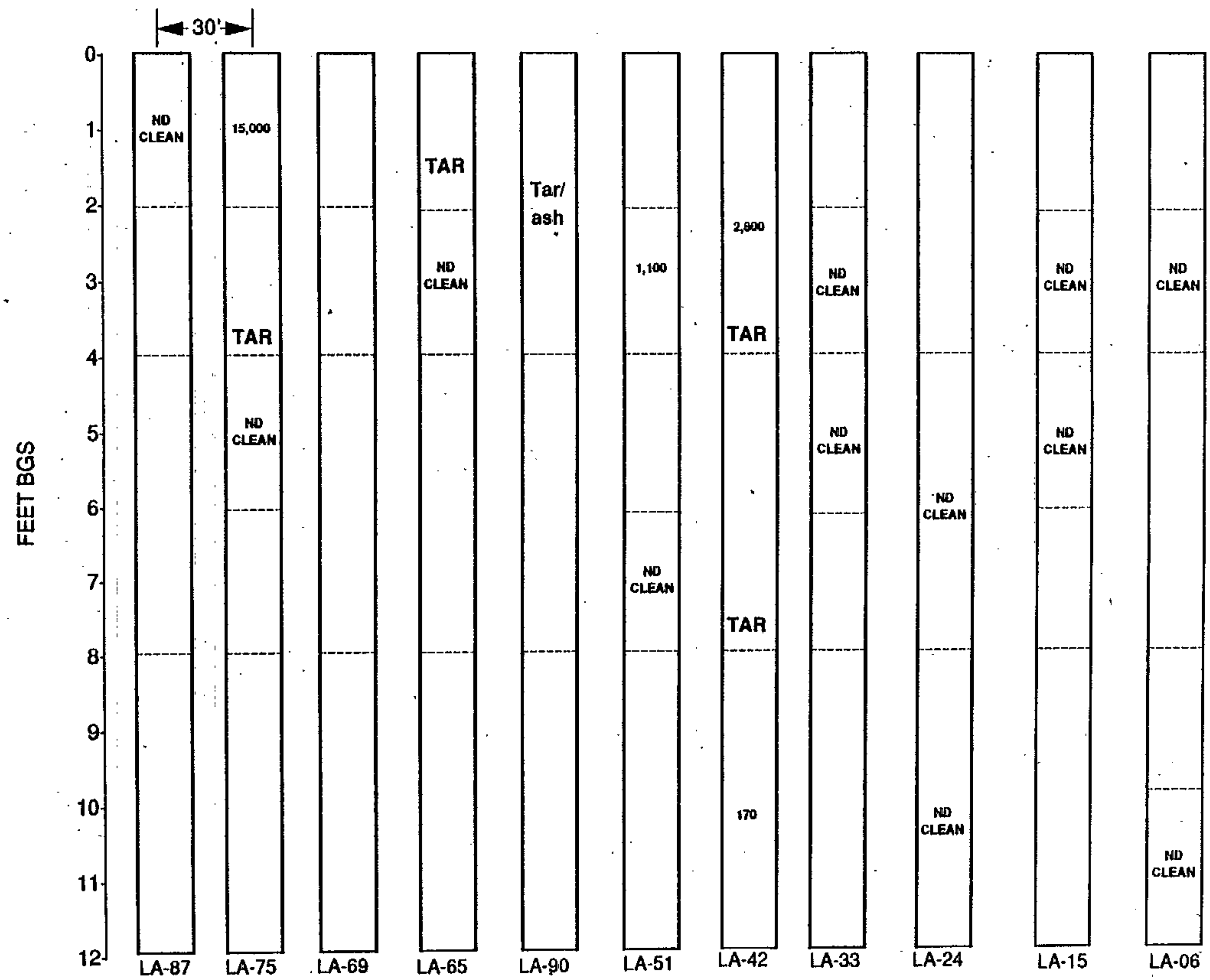

FIGURE 3-4
LAGOON AREA cPAH SOIL PROFILE C-C'
MORGANTOWN ORDNANCE WORKS SITE
MORGANTOWN, WV

ABB Environmental Services, Inc.

6779-11D

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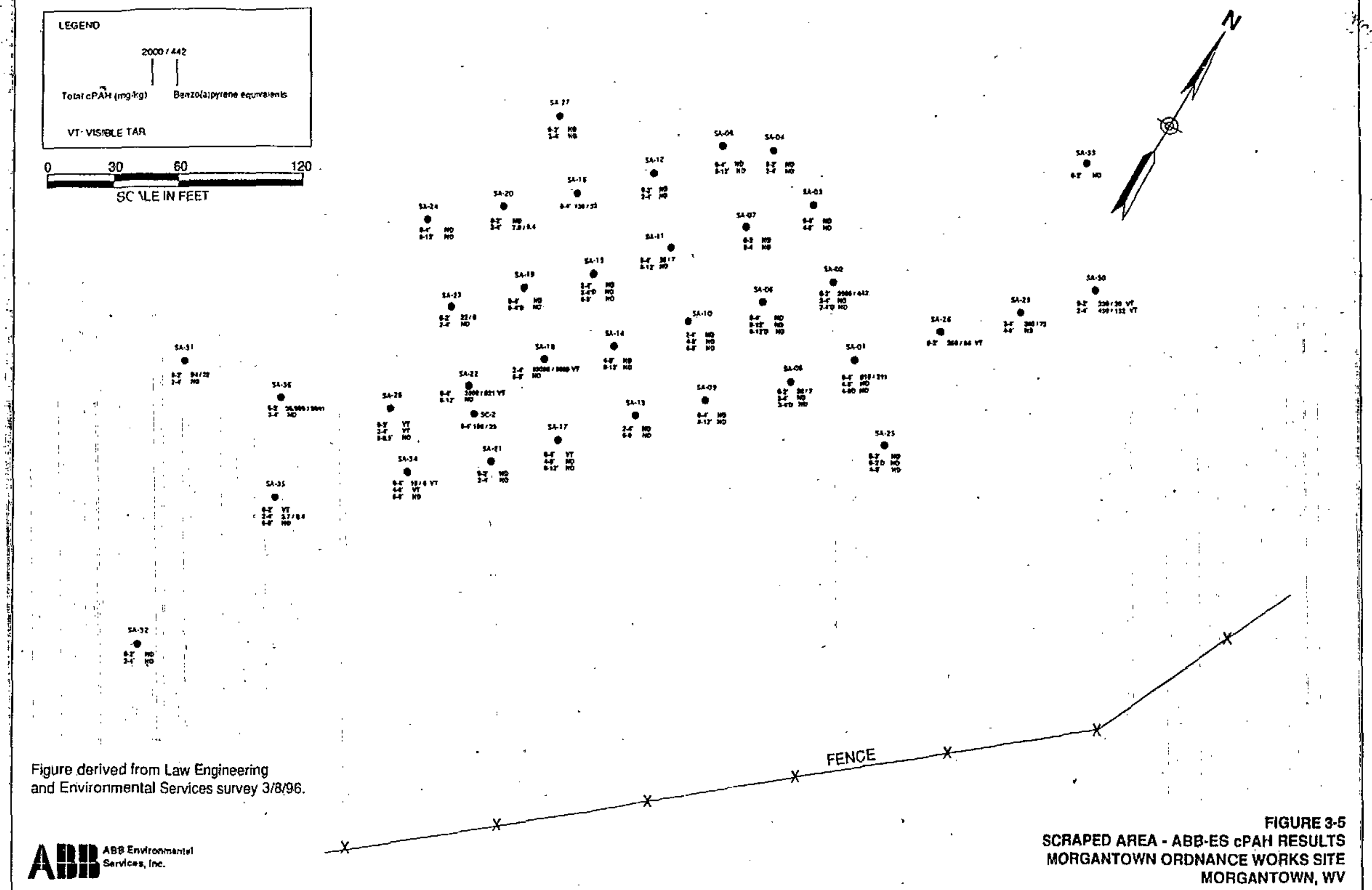

FIGURE 3-5
SCRAPED AREA - ABB-ES cPAH RESULTS
MORGANTOWN ORDNANCE WORKS SITE
MORGANTOWN, WV

3.3.3 Drainage Swales

The Drainage Swale data are presented schematically in Figure 3.7. Review of Figure 3.7 reveals that 9 out of 18 of the Drainage Swale #1 samples were above the existing 78 mg/kg action level, whereas 0 out of 10 of the Drainage Swale #2 and 1 out of 6 of the Drainage Swale #3 samples were above the action level.

There appears to be a localized area of high cPAH contamination (concentrations above 1000 mg/kg) in Drainage Swale #1, in the DS1-03 to DS1-04 area. The surficial soils in this area are overlain by a thin crust of apparent tar at the land surface while the soil under this crust contains no detectable cPAHs.

3.4 cPAH Confirmation

Ten percent of the samples analyzed by the ABB-ES laboratory for cPAHs were sub-sampled and sent to IEA for confirmatory analysis. As specified in the approved workplan these confirmatory samples were chosen to represent a wide variety of cPAH concentrations as determined by ABB-ES screening analysis (high, medium, low, and nondetect). IEA analyzed these confirmatory samples by GC/MS, Method 8270.

The results of the confirmatory analyses and a comparison to ABB-ES results are presented in Table 3-3. The data report package for the IEA cPAH results is presented in Appendix C.

cPAH results from the two labs were first compared directly by calculating the Relative Percent Difference (RPD) . The RPD goal established for this project was 40%. Results showed that 65% of the samples met the project goals, an additional 10% were in the RPD range of 41-75% and the remaining 25% had an RPD above 75%.

The variability between samples is likely to due the heterogeneous nature of the soil, rather than to differences in methods between laboratories. To further investigate the comparability of the samples, ABB-ES has also statistically evaluated the duplicate sample results between the IEA and ABB-ES laboratories using regression analysis. Calculations are provided in Appendix D and summarized below.

The output from the regression analysis produced the following statistics:

- Slope of the regression line (ABB-ES values on the y-axis): 0.96
- 95% confidence interval on the slope: 0.81 to 1.12
- R squared: 0.824

Twenty of the thirty-one duplicate analyses fell within the Work Plan goal of 40% relative percent difference. The closeness of the regression line slope to 1.00 shows that the variations between the laboratories were random and not systematic, consistent with the heterogeneous soil matrix found at OU 1.

3.5 Laboratory Data QC

3.5.1 ABB Wakefield Laboratory cPAH Results

cPAHs were analyzed by ABB-ES' Treatability Laboratory following Modified EPA Method 3550/8100 (Appendix E). Quality control parameters were reviewed to evaluate the data quality and determine if data quality objectives established for the project (Phase II Interim Tasks Work Plan) had been met and to qualify data as required. The specific parameters that were reviewed included:

- holding times;
- surrogate recoveries;
- blank results;
- MS/MSD results; and
- duplicate results.

The results from this data review indicates that all data are usable. Some data were qualified as estimated for reasons described in this section.

All samples analyzed by ABB-ES were extracted and analyzed within required holding times.

No target compounds (PAHs/cPAHs) were detected in any of the method blanks.

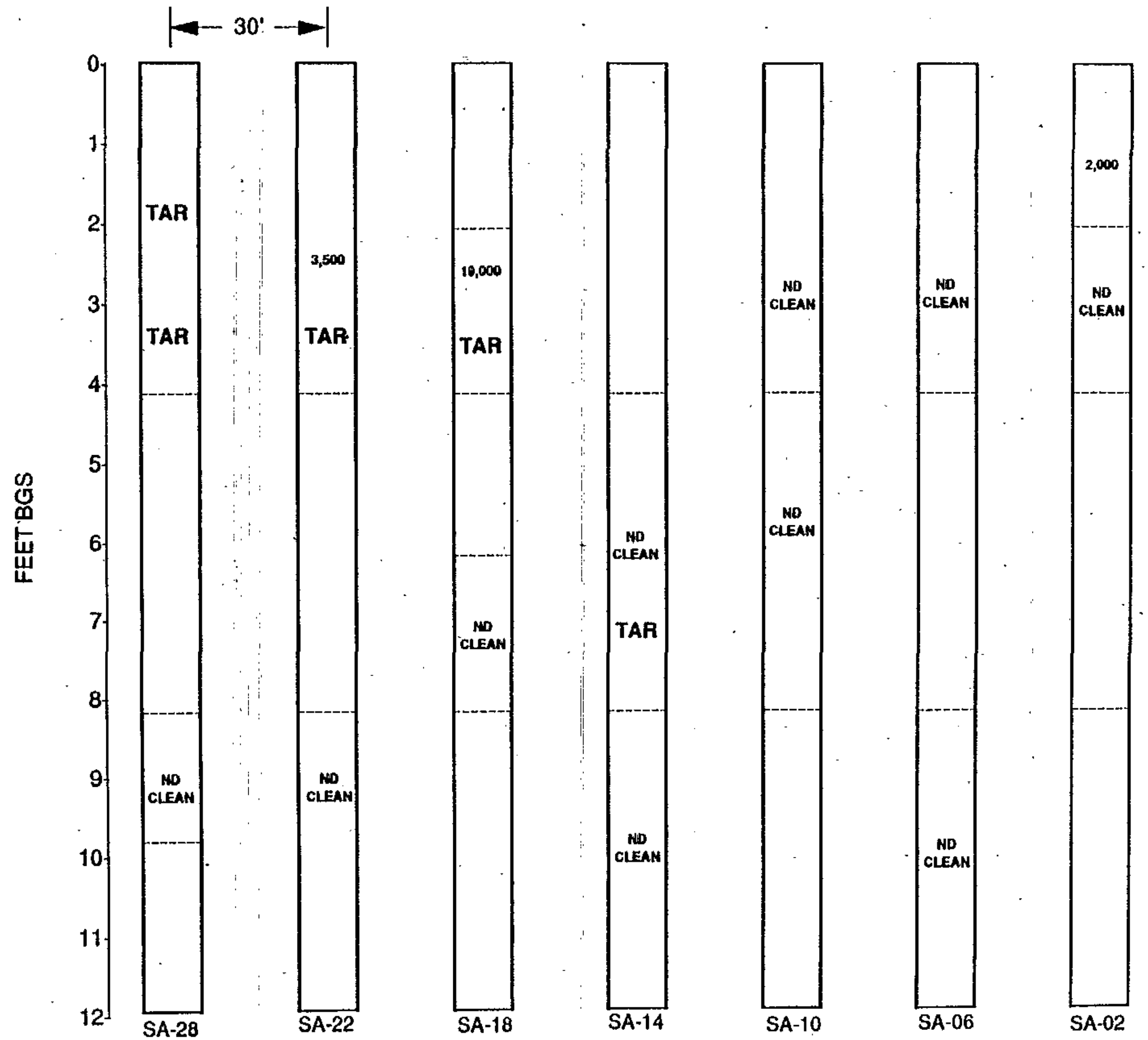

FIGURE 3-6
SCRAPED AREA cPAH SOIL PROFILE D-D'
MORGANTOWN ORDNANCE WORKS SITE
MORGANTOWN, WV

ABB Environmental Services, Inc.

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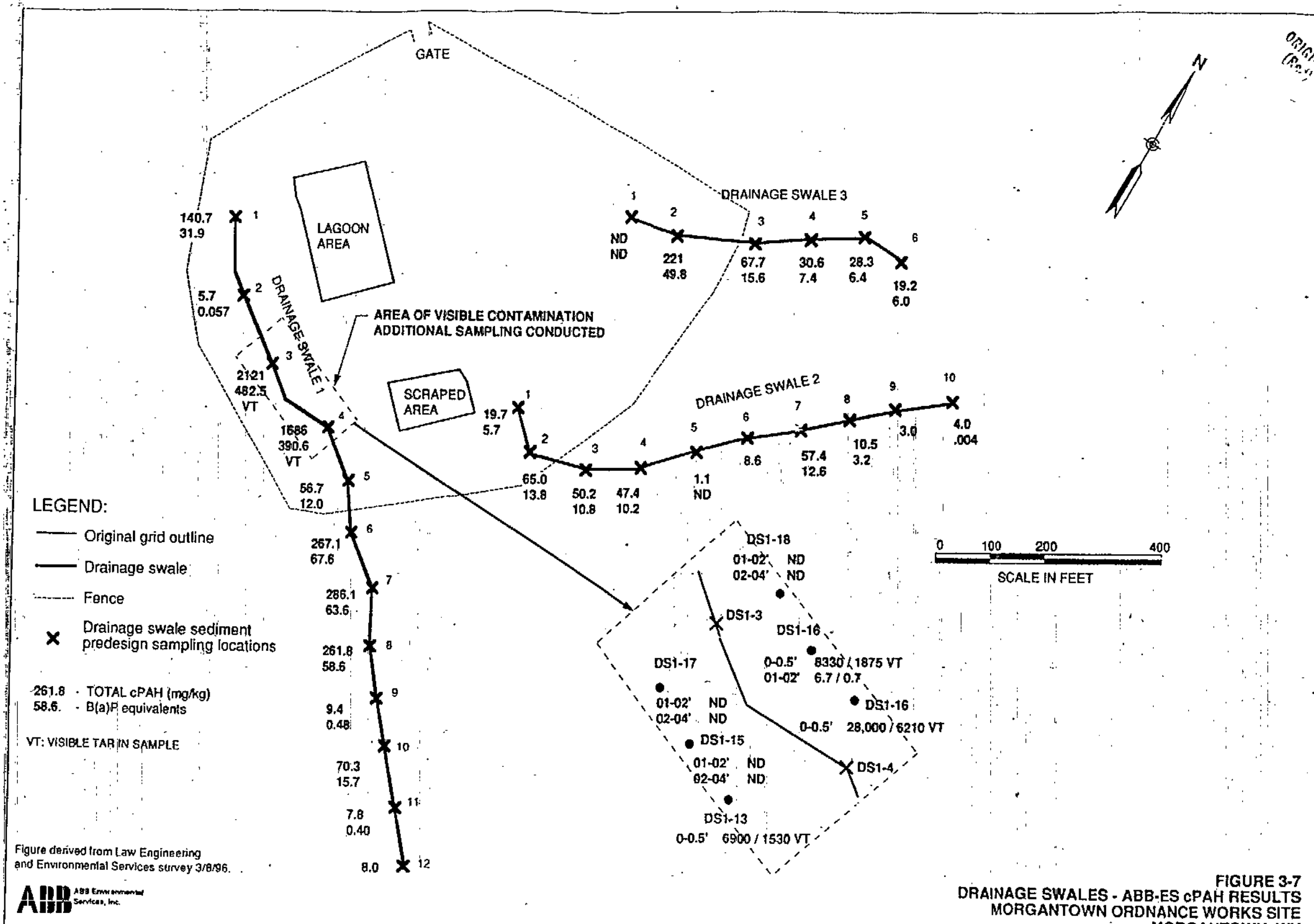

FIGURE 3-7
DRAINAGE SWALES - ABB-ES cPAH RESULTS
MORGANTOWN ORDNANCE WORKS SITE
MORGANTOWN, WV

AR302338

Table 3-3: Confirmatory cPAH Results and Comparison

	IEA	ABB	
Sample ID:	DS1-13-00-0.5	DS1-13-00-0.5	
Lab ID:	960521330	Q2A1F20E	
Date Sampled:	5/8/96	5/8/96	RPD
cPAH (mg/Kg)			
Benzo(a)anthracene	220	120.4	59
Benzo(a)pyrene	170	90.2	61
Benzo(b)fluoranthene	110	66.3	50
Benzo(k)fluoranthene	180	78.8	78
Chrysene	180	96.8	60
Dibenzo(a,h)anthracene	41	11.2	114
Indeno(1,2,3-cd)pyrene	87	46.2	61
Total cPAH	988	510	64

	IEA	ABB	
Sample ID:	DS1-14-00-0.5	DS1-14-00-0.5	
Lab ID:	960521329	Q2A1E3EE	
Date Sampled:	5/8/96	5/8/96	RPD
cPAH (mg/Kg)			
Benzo(a)anthracene	2.1	11.1	136
Benzo(a)pyrene	1.7	9.6	140
Benzo(b)fluoranthene	1.5	7.5	133
Benzo(k)fluoranthene	1.5	8.5	140
Chrysene	1.8	10.1	139
Dibenzo(a,h)anthracene	0.46	< 6.8	AGREE
Indeno(1,2,3-cd)pyrene	0.96	< 6.8	AGREE
Total cPAH	10.02	46.7	129

	IEA	ABB	
Sample ID:	DS1-16-01-02	DS1-16-01-02	
Lab ID:	960521327	Q2A1C53D	
Date Sampled:	5/8/96	5/8/96	RPD
cPAH (mg/Kg)			
Benzo(a)anthracene	2.2	< 6.3	AGREE
Benzo(a)pyrene	1.8	< 6.3	AGREE
Benzo(b)fluoranthene	1.4	< 6.3	AGREE
Benzo(k)fluoranthene	1.8	< 6.3	AGREE
Chrysene	2	< 6.3	AGREE
Dibenzo(a,h)anthracene	0.46	< 6.3	AGREE
Indeno(1,2,3-cd)pyrene	0.96	< 6.3	AGREE
Total cPAH	10.62	< 6.3	AGREE

	IEA	ABB	
Sample ID:	DS2-09	DS2-09	
Lab ID:	960521332	Q2A22AE6	
Date Sampled:	5/8/96	5/8/96	RPD
cPAH (mg/Kg)			
Benzo(a)anthracene	5.3	22.6	124
Benzo(a)pyrene	4.7	18.4	119
Benzo(b)fluoranthene	4.4	14.3	106
Benzo(k)fluoranthene	4	17.2	125
Chrysene	4.8	20.1	123
Dibenzo(a,h)anthracene	1.4	< 5.9	AGREE
Indeno(1,2,3-cd)pyrene	2.6	9.5	114
Total cPAH	27.2	102.1	116

	IEA	ABB	ABB		
Sample ID:	DS3-03	DS3-03	DS3-03 DUP		
Lab ID:	960521323	Q2A16FB7	Q2A17E0B		
Date Sampled:	5/8/96	5/8/96	5/8/96	ABB AVG	RPD
cPAH (mg/Kg)					
Benzo(a)anthracene	4.3	18.8	17.9	18.35	124
Benzo(a)pyrene	4	13.8	13.5	13.65	70
Benzo(b)fluoranthene	3.2	10.8	10	10.4	68
Benzo(k)fluoranthene	3.7	13.4	12.9	13.15	71
Chrysene	3.9	14.8	13.3	14.05	70
Dibenzo(a,h)anthracene	0.89	< 9.	< 8.8	< 9.	AGREE
Indeno(1,2,3-cd)pyrene	2	< 9.	< 8.8	< 9.	AGREE
Total cPAH	21.99	71.5	67.5	69.5	104

	IEA	ABB	
Sample ID:	LA-07-00-02	LA-07-00-02	
Lab ID:	960521307	Q29ED013	
Date Sampled:	5/7/96	5/7/96	RPD
cPAH (mg/Kg)			
Benzo(a)anthracene	19	5.9	105
Benzo(a)pyrene	16	< 5.9	N/A
Benzo(b)fluoranthene	15	< 5.9	N/A
Benzo(k)fluoranthene	14	< 5.9	N/A
Chrysene	17	< 5.9	N/A
Dibenzo(a,h)anthracene	4.4	< 5.9	N/A
Indeno(1,2,3-cd)pyrene	9.2	< 5.9	N/A
Total cPAH	94.6	5.9	177

	IEA	ABB	
Sample ID:	LA-16-04-08	LA-16-04-08	
Lab ID:	960521306	Q29EC1DA	
Date Sampled:	5/7/96	5/7/96	RPD
cPAH (mg/Kg)			
Benzo(a)anthracene	< 0.44	< 6.1	AGREE
Benzo(a)pyrene	< 0.44	< 6.1	AGREE
Benzo(b)fluoranthene	< 0.44	< 6.1	AGREE
Benzo(k)fluoranthene	< 0.44	< 6.1	AGREE
Chrysene	< 0.44	< 6.1	AGREE
Dibenzo(a,h)anthracene	< 0.44	< 6.1	AGREE
Indeno(1,2,3-cd)pyrene	< 0.44	< 6.1	AGREE
Total cPAH	<0.44	< 6.1	AGREE

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Table 3-3: Confirmatory cPAH Results and Comparison (continued)

	IEA	ABB	ABB			IEA	ABB	
Sample ID: Lab ID: Date Sampled:	LA-17-00-02 960521309 5/7/96	LA-17-00-02 Q29EEC74 5/7/96	LA-17-00-02 DUP Q29EFAA3 5/7/96	ABB AVG	RPD	LA-22-04-08 960521316 5/7/96	LA-22-04-08 Q2A0421A 5/7/96	RPD
cPAH (mg/Kg)								
Benzo(a)anthracene	3.4	12.5	18	15.25	127	0.31	< 5.9	AGREE
Benzo(a)pyrene	3.7	11.2	16	13.6	80	0.2	< 5.9	AGREE
Benzo(b)fluoranthene	3.2	9.1	12.2	10.65	75	0.16	< 5.9	AGREE
Benzo(k)fluoranthene	3.4	10.3	14.6	12.45	80	0.16	< 5.9	AGREE
Chrysene	3.2	11.4	17.1	14.25	86	0.26	< 5.9	AGREE
Dibenzo(a,h)anthracene	0.8	< 6.1	< 5.9	< 6.1	AGREE	0.048	< 5.9	AGREE
Indeno(1,2,3-cd)pyrene	1.7	6.4	9.1	7.75	86	0.1	< 5.9	AGREE
Total cPAH	19.4	60.8	87	73.9	117	1.238	< 5.9	AGREE

	IEA	IEA	ABB	ABB		IEA	ABB	
Sample ID: Lab ID: Date Sampled:	LA-22-08-12 960521319 5/7/96	LA-22-08-12 DUP 960521311 5/7/96	LA-22-08-12 Q2A0A6A6 5/7/96	LA-22-08-12D Q29F16E2 5/7/96	RPD	LA-25-00-02 960521312 5/7/96	LA-25-00-02 Q29FF996 5/7/96	RPD
cPAH (mg/Kg)								
Benzo(a)anthracene	<0.43	<0.44	< 6.	< 6.3	AGREE	62	57.8	7
Benzo(a)pyrene	<0.43	<0.44	< 6.	< 6.3	AGREE	46	62.9	31
Benzo(b)fluoranthene	<0.43	<0.44	< 6.	< 6.3	AGREE	40	53.1	28
Benzo(k)fluoranthene	<0.43	<0.44	< 6.	< 6.3	AGREE	46	54.6	17
Chrysene	<0.43	<0.44	< 6.	< 6.3	AGREE	51	53.1	4
Dibenzo(a,h)anthracene	<0.43	<0.44	< 6.	< 6.3	AGREE	14	10.6	28
Indeno(1,2,3-cd)pyrene	<0.43	<0.44	< 6.	< 6.3	AGREE	28	39.2	33
Total cPAH	<0.43	<0.44	< 6.	< 6.3	AGREE	287	331.4	14

	IEA	ABB		IEA	ABB	
Sample ID: Lab ID: Date Sampled:	LA-27-00-02 960521314 5/7/96	LA-27-00-02 Q2A025BA 5/7/96	RPD	LA-40-00-03 960521317 5/7/96	LA-40-00-03 Q2A0503F 5/7/96	RPD
cPAH (mg/Kg)						
Benzo(a)anthracene	22	12.8	53	4100	3926	4
Benzo(a)pyrene	20	14	35	3400	3252.3	4
Benzo(b)fluoranthene	17	11.9	35	2700	2471.5	9
Benzo(k)fluoranthene	19	12.9	38	3100	2461.9	23
Chrysene	21	12.8	49	3400	3136.4	8
Dibenzo(a[illegible]ene	5.7	< 6.9	N/A	75[illegible]	383.5	65
Indeno(1,2,[illegible]pyrene	12	8.4	35	160[illegible]	1523.1	5
Total cPAH	116.7	72.9	46	19050	17154.8	10

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Table 3-3: Confirmatory cPAH Results and Comparison (continued)

	IEA	ABB	ABB		
Sample ID:	LA-42-00-04	LA-42-00-04	LA-42-00-04 DUP		
Lab ID:	960521313	Q2A007CC	Q2A01679		
Date Sampled:	5/7/96	5/7/96	5/7/96	ABB AVG	RPD
cPAH (mg/Kg)					
Benzo(a)anthracene	130	216.3	339.4	277.85	73
Benzo(a)pyrene	110	195.6	280.9	238.25	59
Benzo(b)fluoranthene	110	177.2	270.1	223.65	57
Benzo(k)fluoranthene	93	167.3	231.2	199.25	58
Chrysene	110	206.1	281.1	243.6	59
Dibenzo(a,h)anthracene	34	29.2	37.6	33.4	2
Indeno(1,2,3-cd)pyrene	65	115.4	144.6	130	53
Total cPAH	652	1107.1	1584.9	1346	69

IEA	ABB	
LA-44-08-12	LA-44-08-12	
960521320	Q2A0B4A9	
5/7/96	5/7/96	RPD
1	<6.1	AGREE
0.9	<6.1	AGREE
0.58	<6.1	AGREE
0.8	<6.1	AGREE
0.8	<6.1	AGREE
3.9	<6.1	AGREE
0.42	<6.1	AGREE
8.4	<6.1	N/A

	IEA	ABB	
Sample ID:	LA-75-00-02	LA-75-00-02	
Lab ID:	960521305	Q29EB204	
Date Sampled:	5/7/96	5/7/96	RPD
cPAH (mg/Kg)			
Benzo(a)anthracene	3100	2875.5	8
Benzo(a)pyrene	2600	2233.9	15
Benzo(b)fluoranthene	2300	1685.8	31
Benzo(k)fluoranthene	2100	1813.3	15
Chrysene	2600	2126.8	20
Dibenzo(a,h)anthracene	590	266.2	76
Indeno(1,2,3-cd)pyrene	1200	1131.4	6
cTotal PAH	14490	12132.8	18

IEA	ABB	
LA-75-04-06	LA-75-04-06	
960521315	Q2A033F1	
5/7/96	5/7/96	RPD
<1.6	<6.1	AGREE
<1.6	<6.1	AGREE
<1.6	<6.1	AGREE
<1.6	<6.1	AGREE
<1.6	<6.1	AGREE
<1.6	<6.1	AGREE
<1.6	<6.1	AGREE
<1.6	<6.1	AGREE

IEA	ABB	
LA-76-00-02	LA-76-00-02	
960521304	Q29EA376	
5/7/96	5/7/96	RPD
28	129.7	129
26	112.8	125
28	104.8	116
18	91.1	134
25	125.3	133
8.1	16.2	67
17	63.6	116
150.1	643.6	124

	IEA	ABB	
Sample ID:	LA-77-02-04	LA-77-02-04	
Lab ID:	960521318	Q2A06048	
Date Sampled:	5/7/96	5/7/96	RPD
cPAH (mg/Kg)			
Benzo(a)anthracene	<0.4	< 6.	AGREE
Benzo(a)pyrene	<0.4	< 6.	AGREE
Benzo(b)fluoranthene	<0.4	< 6.	AGREE
Benzo(k)fluoranthene	<0.4	< 6.	AGREE
Chrysene	<0.4	< 6.	AGREE
Dibenzo(a,h)anthracene	<0.4	< 6.	AGREE
Indeno(1,2,3-cd)pyrene	<0.4	< 6.	AGREE
Total cPAH	<0.4	< 6.	AGREE

IEA	IEA	ABB	ABB	
LA-80-00-02	LA-80-00-02 DUP	LA-80-00-02	LA-80-00-02D	
960521334	960521324	Q2A18C55	Q2A19A96	
5/8/96	5/8/96	5/8/96	5/8/96	RPD
0.054	<0.41	< 5.9	< 6.3	AGREE
0.068	<0.41	< 5.9	< 6.3	AGREE
<0.43	<0.41	< 5.9	< 6.3	AGREE
<0.43	<0.41	< 5.9	< 6.3	AGREE
0.048	<0.41	< 5.9	< 6.3	AGREE
<0.43	<0.41	< 5.9	< 6.3	AGREE
<0.43	<0.41	< 5.9	< 6.3	AGREE
0.17	<0.41	< 5.9	< 6.3	AGREE

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Table 3-3: Confirmatory cPAH Results and Comparison (continued)

	IEA	ABB		IEA	ABB		IEA	ABB	
Sample ID:	LA-83-04-06	LA-83-04-06		LA-96-00-02	LA-96-00-02		LA-99-00-02	LA-99-00-02	
Lab ID:	960521322	Q2A0D0BE		960521328	Q2A1D36A		960521321	Q2A0C2B1	
Date Sampled:	5/7/96	5/7/96	RPD	5/8/96	5/8/96	RPD	5/7/96	5/7/96	RPD
cPAH (mg/Kg)									
Benzo(a)anthracene	<0.41	< 6.1	AGREE	1100	3603.2	106	0.51	< 6.	AGREE
Benzo(a)pyrene	<0.41	< 6.1	AGREE	860	2545.6	99	0.41	< 6.	AGREE
Benzo(b)fluoranthene	<0.41	< 6.1	AGREE	690	2018.5	98	0.38	< 6.	AGREE
Benzo(k)fluoranthene	<0.41	< 6.1	AGREE	730	2064.1	95	0.41	< 6.	AGREE
Chrysene	<0.41	< 6.1	AGREE	880	2711.7	102	0.39	< 6.	AGREE
Dibenzo(a,h)anthracene	<0.41	< 6.1	AGREE	210	296.8	34	0.1	< 6.	AGREE
Indeno(1,2,3-cd)pyrene	<0.41	< 6.1	AGREE	410	1309.7	105	0.19	< 6.	AGREE
Total cPAH	<0.41	< 6.1	AGREE	4880	14549.6	100	2.39	< 6.	AGREE

	IEA	ABB		IEA	ABB		IEA	ABB	
Sample ID:	SA-01-00-04	SA-01-00-04		SA-01-04-08	SA-01-04-08		SA-13-02-04	SA-13-02-04	
Lab ID:	960521310	Q29F08C3		9605213208	Q29EDE49		960521303	Q29E9537	
Date Sampled:	5/7/96	5/7/96	RPD	5/7/96	5/7/96	RPD	5/7/96	5/7/96	RPD
cPAH (mg/Kg)									
Benzo(a)anthracene	5.9	8.9	41	<0.39	< 5.8	AGREE	< 0.41	< 5.7	AGREE
Benzo(a)pyrene	4.8	6.2	25	<0.39	< 5.8	AGREE	< 0.41	< 5.7	AGREE
Benzo(b)fluoranthene	4.1	< 6.	AGREE	<0.39	< 5.8	AGREE	< 0.41	< 5.7	AGREE
Benzo(k)fluoranthene	4	< 6.	AGREE	<0.39	< 5.8	AGREE	< 0.41	< 5.7	AGREE
Chrysene	4.9	6.7	31	<0.39	< 5.8	AGREE	< 0.41	< 5.7	AGREE
Dibenzo(a,h)anthracene	1.4	< 6.	AGREE	<0.39	< 5.8	AGREE	< 0.41	< 5.7	AGREE
Indeno(1,2,3-cd)pyrene	2.8	< 6.	AGREE	<0.39	< 5.8	AGREE	< 0.41	< 5.7	AGREE
Total cPAH	27.9	21.7	25	<0.39	< 5.8	AGREE	<0.41	< 5.7	AGREE

	IEA	IEA	ABB	ABB		IEA	ABB	
Sample ID:	SA-13-06-08	SA-13-06-08 DUP	SA-13-06-08	SA-13-06-08 DUP		SA-30-00-02	SA-30-00-02	
Lab ID:	960521301	960521302	Q29ADCAA	Q29E8705		960521333	Q2A23908	
Date Sampled:	5/7/96	5/7/96	5/7/96	5/7/96	RPD	5/8/96	5/8/96	RPD
cPAH (mg/Kg)								
Benzo(a)anthracene	<0.37	<0.37	< 4.8	< 4.8	AGREE	4.8	27.3	140
Benzo(a)pyrene	<0.37	<0.37	< 4.8	< 4.8	AGREE	4.1	20.6	134
Benzo(b)fluoranthene	<0.37	<0.37	< 4.8	< 4.8	AGREE	3.2	14.9	129
Benzo(k)fluoranthene	<0.37	<0.37	< 4.8	< 4.8	AGREE	4.2	18.8	127
Chrysene	<0.37	<0.37	< 4.8	< 4.8	AGREE	4	24.4	144
Dibenzo(a,[illegible]cene	<0.37	<0.37	< 4.8	< 4.8	AGREE	1.2	< 6.3	AGREE
Indeno(1,2,[illegible]rene	<0.37	<0.37	< 4.8	< 4.8	AGREE	2.4	10.1	123
Total cPAH	<0.37	<0.37	< 4.8	< 4.8	AGREE	23.9	116	132

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Table 3-3: Confirmatory cPAH Results and Comparison (continued)

	IEA	ABB		IEA	ABB		IEA	ABB	
Sample ID:	SA-32-00-02	SA-32-00-02		SA-32-02-04	SA-32-02-04		SC-02-00-02	SC-02-00-02	
Lab ID:	960521326	Q2A1B707		960521325	Q2A1A8D3		960521331	Q2A21CCC	
Date Sampled:	5/8/96	5/8/96	RPD	5/8/96	5/8/96	RPD	5/8/96	5/8/96	RPD
cPAH (mg/Kg)									
Benzo(a)anthracene	<0.4	< 6.	AGREE	0.24	< 5.9	AGREE	0.16	< 6.3	AGREE
Benzo(a)pyrene	<0.4	< 6.	AGREE	0.25	< 5.9	AGREE	0.12	< 6.3	AGREE
Benzo(b)fluoranthene	<0.4	< 6.	AGREE	0.22	< 5.9	AGREE	0.13	< 6.3	AGREE
Benzo(k)fluoranthene	<0.4	< 6.	AGREE	0.25	< 5.9	AGREE	0.12	< 6.3	AGREE
Chrysene	<0.4	< 6.	AGREE	0.22	< 5.9	AGREE	0.16	< 6.3	AGREE
Dibenzo(a,h)anthracene	<0.4	< 6.	AGREE	0.07	< 5.9	AGREE	<0.42	< 6.3	AGREE
Indeno(1,2,3-cd)pyrene	<0.4	< 6.	AGREE	0.15	< 5.9	AGREE	0.07	< 6.3	AGREE

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The goal of a 40% RPD was met for 30 of the 32 duplicates analyzed by ABB-ES (internal duplicates different from those split with IEA). The samples not meeting the RPD goal were qualified as estimated. The duplicate results are presented in Table 3-4.

Surrogate recoveries were met with the exception of 8 samples. In 7 cases, the surrogate recovery exceeded the 130% limit, which appears to be caused by matrix interference due to high levels of PAHs present in those soil samples. These data were qualified as estimated. The surrogate recovery results are summarized and presented in Table 3-5.

The results from Matrix Spike and Matrix Spike Duplicate analysis indicate that precision and accuracy criteria were met with the exception of SA-22-00-04. The corresponding samples were qualified as required for any compounds not meeting recovery and RPD goals.

3.5.2 ESE Metals Results

Ten samples and a field duplicate were received by ESE in Gainesville for analysis for arsenic by EPA SW-846 method 7060 (GFAA) and copper and lead by EPA SW-846 Method 6010 (ICP) on February 6, 1996. Examination of the chain-of-custody and associated cooler receipt form from the laboratory indicated no discrepancies and all samples were received properly preserved (chilled) and in good condition. All holding times were met (180 days).

All initial and continuing calibrations were run with the correct frequency and were within acceptable limits. Standard matrix spikes were all within acceptable percent recovery limits. All method blanks and continuing calibration blanks showed no contamination above the contract required detection limits for both the ICP and AA data. A field duplicate was collected for sample BR-E9-08-10. The relative percent difference for arsenic, cadmium and copper were within the +- 2X CRDL criteria of the EPA Region I Functional Guidelines for Evaluating Inorganics Analyses and the 50 % RPD stated in the project workplan. The lead results were within two times the quantitation limit for lead using ICP.

Matrix spike/matrix spike duplicate analyses were performed on sample SC-D2-00-04 for lead copper, cadmium and arsenic. The percent recoveries were not within the EPA-specified control limits of 70% - 125%. However, the concentration of copper in the unspiked sample exceeded four times the spiking level and was therefore acceptable. Arsenic recovery was also potentially affected by matrix interferences present in the soil as reported by the laboratory. In addition, a serial dilution was run for arsenic which had an acceptable percent difference of 5.8.

A level IV data package was received for all data and was well-organized and complete.

Table 3-4: ABB-ES Wakefield Laboratory Quality Control Results- Duplicate Comparison (RPD)

Sample ID	Date Sampled	ABB Lab ID	Total cPAH (mg/kg)	Relative Percent Difference
DS1-03	10-Feb-96	Q224572A	2121.4	
DS1-03D	10-Feb-96	Q224659C	2162.8	2%
DS1-11	10-Feb-96	Q224CF32	7.8	
DS1-11D	10-Feb-96	Q224DBE2	25.4	106%
DS1-15-01-02	14-Feb-96	Q22A0950	< 3.2	
DS1-15-01-02D	14-Feb-96	Q22A161D	< 3.0	Acceptable
DS2-07	10-Feb-96	Q223DF25	57.5	
DS2-07D	10-Feb-96	Q223EC02	48.9	16%
DS3-01	09-Feb-96	Q2222D29	< 7.8	
DS3-01D	09-Feb-96	Q2223A0d	< 7.2	Acceptable
DS3-03	08-May-96	Q2A16FB7	71.5	
DS3-03D	08-May-96	Q2A17E0B	67.5	6%
LA-10-02-03	02-Feb-96	Q2198A7F	< 3.1	
LA-10-02-03D	02-Feb-96	Q219971F	< 3.2	Acceptable
LA-12-00-02	04-Feb-96	Q21C46E4	< 3.8	
LA-12-00-02D	04-Feb-96	Q21C53D7	< 3.6	Acceptable
LA-14-08-12	07-Feb-96	Q21F5F3C	< 2.8	
LA-14-08-12D	07-Feb-96	Q21F6C2B	< 2.7	Acceptable
LA-17-00-02	15-Feb-96	Q22BF675	18.0	
LA-17-00-02D	15-Feb-96	Q22C0364	191.7	166%
LA-17-00-02	07-May-96	Q29EEC74	60.8	
LA-17-00-02D	07-May-96	Q29EFAA3	87.0	35%
LA-22-08-12	07-Jun-96	Q2A0A6A6	< 6.0	
LA-22-08-12D	07-May-96	Q29F16E2	< 6.3	Acceptable
LA-31-04-06	13-Feb-96	Q228467D	155.9	
LA-31-04-06D	13-Feb-96	Q2285367	188.2	19%
LA-34-00-04	09-Feb-96	Q222D230	< 2.9	
LA-34-00-04D	09-Feb-96	Q222DF28	3.2	Acceptable
LA-36-00-04	03-Feb-96	Q21B2D51	< 3.4	
LA-36-00-04D	03-Feb-96	Q21B3A07	< 3.4	Acceptable
LA-42-00-04	07-Feb-96	Q21F92E3	2800.0	
LA-42-00-04D	07-Feb-96	Q21FA133	2008.1	33%
LA-42-00-04	07-May-96	Q2A007CC	1107.1	
LA-42-00-04D	07-May-96	Q2A01679	1584.9	35%
LA-46-03-04	02-Feb-96	Q219E2D8	< 3.1	
LA-46-03-04D	02-Feb-96	Q219FBF9	4.9	Acceptable
LA-52-08-12	03-Feb-96	Q21B9378	< 3.0	
LA-52-08-12D	03-Feb-96	Q21BA028	< 3.0	Acceptable
LA-53-10-12	13-Feb-96	Q227F8CF	< 2.9	
LA-53-10-12D	13-Feb-96	Q22805C4	< 2.9	Acceptable
LA-72-02-04	14-Feb-96	Q22ED9DD	< 2.8	
LA-72-02-04D	14-Feb-96	Q22FA8BA	< 3.0	Acceptable
LA-80-00-02	08-May-96	Q2A18C55	< 5.9	
LA-80-00-02D	08-May-96	Q2A19A96	< 6.3	Acceptable
LA-84-06-08	16-Feb-96	Q22EF3BC	< 3.1	
LA-84-06-08D	16-Feb-96	Q22FB59D	< 3.0	Acceptable
LA-93-04-06	16-Feb-96	Q22DEC77	< 3.1	
LA-93-04-06D	16-Feb-96	Q22DF984	< 2.9	Acceptable
SA-01-04-08	06-Feb-96	Q21E4D85	< 2.8	
SA-01-04-08D	06-Feb-96	Q21E71AE	< 0.3	Acceptable
SA-02-02-04	11-Feb-96	Q226D67D	< 3.1	
SA-02-02-04D	11-Feb-96	Q226E370	< 3.1	Acceptable
SA-05-02-04	11-Feb-96	Q225C559	< 3.1	
SA-05-02-04D	11-Feb-96	Q225D241	< 3.0	Acceptable
SA-06-08-12	06-Feb-96	Q21E7492	< 2.6	
SA-06-08-12D	06-Feb-96	Q21E91AE	< 2.5	Acceptable
SA-13-06-08	07-May-96	Q29ADCAA	< 4.8	
SD-13-06-08	07-May-96	Q29E8705	< 4.8	Acceptable
SA-15-02-04	13-Feb-96	Q228F002	< 3.1	
SA-15-02-04D	13-Feb-96	Q228FCE8	< 3.1	Acceptable
SA-19-00-04	07-Feb-96	Q21EC390	< 3.1	
SA-19-00-04D	07-Feb-96	Q21ED001	< 3.0	Acceptable
SA-25-00-02	14-Feb-96	Q22F275E	< 3.0	
SA-25-00-02D	16-Feb-96	Q22FC291	< 3.2	Acceptable

"Acceptable" indicates that both results were below quantitation limits or within 2 times the sample quantitation limit

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Table 3-5 ABB-ES Wakefield Laboratory Quality Control Results-Surrogate Recovery

Sample ID	Date Sampled	Date Analyzed	Para-terphenyl Recovery (%Rec)
12.5 PPM STD		05-Feb-96	104
12.5 PPM STD		07-Feb-96	93
50 PPM STD		19-Feb-96	97
50 PPM STD		17-Feb-96	98
50 PPM STD		16-Feb-96	97
50 PPM STD		16-Feb-96	98
50 PPM STD		16-Feb-96	98
50 PPM STD		17-Feb-96	98
50 PPM STD		13-Feb-96	98
50 PPM STD		20-Feb-96	97
50 PPM STD		21-Feb-96	95
50 PPM STD		21-Feb-96	95
50 PPM STD		22-Feb-96	93
50 PPM STD		18-Feb-96	97
50 PPM STD		15-Feb-96	109
50 PPM STD		10-Feb-96	96
50 PPM STD		13-Feb-96	95
50 PPM STD		14-Feb-96	69
50 PPM STD		12-Feb-96	98
50 PPM STD		09-Feb-96	97
50 PPM STD		11-Feb-96	96
50 PPM STD		09-Feb-96	97
50 PPM STD		08-Feb-96	97
50 PPM STD		07-Feb-96	98
50 PPM STD		08-Feb-96	97
50 PPM STD		05-Feb-96	100
50 PPM STD		05-Feb-96	97
50 PPM STD		06-Feb-96	97
50 PPM STD		14-Feb-96	97
50 PPM STD		10-Feb-96	97
BLANK		13-Feb-96	95
BLANK		06-Feb-96	96
BLANK		05-Feb-96	97
BLANK		20-May-96	107
BLANK		08-Feb-96	100
BLANK		11-Feb-96	103
BLANK		10-May-96	99
BLANK		17-Feb-96	103
BLANK		19-Feb-96	95
BLANK		14-May-96	93
BLANK		20-Feb-96	95
BLANK		12-Feb-96	99
BLANK		07-Feb-96	96
BLANK		07-Feb-96	107
BLANK		15-May-96	102
DS1-01	10-Feb-96	13-Feb-96	103
DS1-02	10-Feb-96	13-Feb-96	97
DS1-03	10-Feb-96	13-Feb-96	126
DS1-03D	10-Feb-96	13-Feb-96	123
DS1-04	10-Feb-96	14-Feb-96	117
DS1-05	10-Feb-96	14-Feb-96	106
DS1-06	10-Feb-96	14-Feb-96	101
DS1-07	10-Feb-96	14-Feb-96	103
DS1-08	10-Feb-96	14-Feb-96	99
DS1-09	10-Feb-96	14-Feb-96	97
DS1-10	10-Feb-96	14-Feb-96	110
DS1-11	10-Feb-96	14-Feb-96	102
DS1-11D	10-Feb-96	14-Feb-96	97
DS1-12	10-Feb-96	16-Feb-96	106
DS1-13-00-0.5	14-Feb-96	18-Feb-96	189
DS1-13-00-0.5	08-May-96	16-May-96	112
DS1-13-01-02	14-Feb-96	18-Feb-96	91
DS1-14-00-0.5	14-Feb-96	18-Feb-96	175
DS1-14-00-0.5	08-May-96	16-May-96	102
DS1-14-01-02	14-Feb-96	18-Feb-96	99
DS1-15-01-02	14-Feb-96	18-Feb-96	97
DS1-15-01-02D	14-Feb-96	18-Feb-96	103
DS1-15-02-04	14-Feb-96	18-Feb-96	93
DS1-16-00-0.5	14-Feb-96	18-Feb-96	130

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Table 3-5 ABB-ES Wakefield Laboratory Quality Control Results-Surrogate Recovery

Sample ID	Date Sampled	Date Analyzed	Para-terphenyl Recovery (%Rec)
DS1-16-01-02	08-May-96	16-May-96	100
DS1-16-01-02	14-Feb-96	18-Feb-96	99
DS1-17-01-02	14-Feb-96	18-Feb-96	93
DS1-17-02-04	14-Feb-96	18-Feb-96	96
DS1-18-01-02	14-Feb-96	18-Feb-96	95
DS1-18-02-04	14-Feb-96	18-Feb-96	83
DS2-01	10-Feb-96	13-Feb-96	104
DS2-02	10-Feb-96	13-Feb-96	104
DS2-03	10-Feb-96	13-Feb-96	105
DS2-04	10-Feb-96	13-Feb-96	101
DS2-05	10-Feb-96	13-Feb-96	101
DS2-06	10-Feb-96	13-Feb-96	105
DS2-07	10-Feb-96	13-Feb-96	99
DS2-07 DUP	10-Feb-96	13-Feb-96	97
DS2-08	09-Feb-96	12-Feb-96	113
DS2-09	08-May-96	16-May-96	108
DS2-10	09-Feb-96	12-Feb-96	101
DS2-9	09-Feb-96	12-Feb-96	103
DS3-01	09-Feb-96	12-Feb-96	105
DS3-01D	09-Feb-96	12-Feb-96	105
DS3-02	09-Feb-96	12-Feb-96	107
DS3-03	08-May-96	15-May-96	100
DS3-03	09-Feb-96	12-Feb-96	105
DS3-03 DUP.	08-May-96	15-May-96	97
DS3-04	09-Feb-96	12-Feb-96	104
DS3-05	09-Feb-96	12-Feb-96	105
DS3-06	09-Feb-96	12-Feb-96	122
LA-01-00-02	11-Feb-96	15-Feb-96	99
LA-01-02-04	11-Feb-96	15-Feb-96	99
LA-02-00-04	02-Feb-96	05-Feb-96	87
LA-02-05-06	02-Feb-96	05-Feb-96	92
LA-03-02-04	11-Feb-96	14-Feb-96	101
LA-03-04-06	11-Feb-96	15-Feb-96	103
LA-04-02-04	02-Feb-96	05-Feb-96	148
LA-04-07-08	02-Feb-96	05-Feb-96	94
LA-05-02-04	13-Feb-96	17-Feb-96	100
LA-05-04-06	13-Feb-96	17-Feb-96	97
LA-06-02-04	02-Feb-96	05-Feb-96	93
LA-06-10-12	02-Feb-96	05-Feb-96	97
LA-07-00-02	15-Feb-96	20-Feb-96	101
LA-07-00-02	07-May-96	13-May-96	99
LA-07-02-04	15-Feb-96	20-Feb-96	99
LA-08-00-04	03-Feb-96	06-Feb-96	94
LA-08-04-08	03-Feb-96	06-Feb-96	99
LA-09-00-02	15-Feb-96	19-Feb-96	94
LA-09-02-04	15-Feb-96	19-Feb-96	94
LA-10-02-03	02-Feb-96	05-Feb-96	103
LA-10-02-03D	02-Feb-96	05-Feb-96	103
LA-10-04-05	02-Feb-96	05-Feb-96	100
LA-100-00-02	16-Feb-96	21-Feb-96	104
LA-101-02-04	16-Feb-96	21-Feb-96	99
LA-102-00-02	16-Feb-96	22-Feb-96	96
LA-102-02-04	16-Feb-96	22-Feb-96	92
LA-103-00-02	16-Feb-96	22-Feb-96	99
LA-11-00-02	11-Feb-96	14-Feb-96	98
LA-11-02-04	11-Feb-96	14-Feb-96	100
LA-12-00-02	04-Feb-96	07-Feb-96	100
LA-12-00-02D	04-Feb-96	07-Feb-96	98
LA-12-11-12	04-Feb-96	07-Feb-96	96
LA-13-02-04	13-Feb-96	17-Feb-96	139
LA-13-06-08	13-Feb-96	17-Feb-96	93
LA-14-00-04	07-Feb-96	10-Feb-96	107
LA-14-08-12	07-Feb-96	10-Feb-96	108
LA-14-08-12D	07-Feb-96	10-Feb-96	103
LA-15-02-04	15-Feb-96	19-Feb-96	97
LA-15-04-06	15-Feb-96	19-Feb-96	91
LA-16-00-04	09-Feb-96	12-Feb-96	101
LA-16-04-08	09-Feb-96	12-Feb-96	101
LA-16-04-08	07-May-96	13-May-96	102

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Table 3-5 ABB-ES Wakefield Laboratory Quality Control Results-Surrogate Recovery

Sample ID	Date Sampled	Date Analyzed	Para-terphenyl Recovery (%Rec)
LA-17-00-02	07-May-96	13-May-96	100
LA-17-00-02	15-Feb-96	19-Feb-96	92
LA-17-00-02 DUP.	07-May-96	13-May-96	98
LA-17-00-02D	15-Feb-96	19-Feb-96	99
LA-17-02-04	15-Feb-96	19-Feb-96	95
LA-18-00-04	03-Feb-96	06-Feb-96	98
LA-18-07-08	03-Feb-96	06-Feb-96	99
LA-19-00-02	11-Feb-96	14-Feb-96	97
LA-19-02-04	11-Feb-96	14-Feb-96	99
LA-20-03-04	04-Feb-96	07-Feb-96	99
LA-20-04-05	04-Feb-96	07-Feb-96	96
LA-21-04-06	13-Feb-96	17-Feb-96	105
LA-21-06-08	13-Feb-96	17-Feb-96	105
LA-22-04-08	07-Feb-96	09-Feb-96	101
LA-22-04-08	07-May-96	14-May-96	96
LA-22-08-12	07-Feb-96	09-Feb-96	98
LA-22-08-12	07-Jun-96	15-May-96	94
LA-22-08-12D	07-May-96	14-May-96	100
LA-23-02-04	13-Feb-96	17-Feb-96	101
LA-23-06-08	13-Feb-96	17-Feb-96	105
LA-24-04-08	07-Feb-96	10-Feb-96	104
LA-24-08-12	07-Feb-96	10-Feb-96	101
LA-25-00-02	07-May-96	14-May-96	101
LA-25-00-02	15-Feb-96	21-Feb-96	71
LA-25-02-04	15-Feb-96	21-Feb-96	103
LA-26-04-08	09-Feb-96	12-Feb-96	101
LA-26-08-12	09-Feb-96	12-Feb-96	98
LA-27-00-02	07-May-96	14-May-96	90
LA-27-00-02	15-Feb-96	21-Feb-96	87
LA-27-02-04	15-Feb-96	21-Feb-96	93
LA-28-02-03	02-Feb-96	05-Feb-96	96
LA-28-06-07	02-Feb-96	05-Feb-96	99
LA-29-06-08	11-Feb-96	15-Feb-96	96
LA-29-06-08	11-Feb-96	15-Feb-96	101
LA-30-00-02	04-Feb-96	07-Feb-96	80
LA-30-08-09	04-Feb-96	07-Feb-96	95
LA-31-04-06	13-Feb-96	16-Feb-96	109
LA-31-04-06D	13-Feb-96	16-Feb-96	109
LA-31-06-08	13-Feb-96	16-Feb-96	103
LA-32-03-04	04-Feb-96	08-Feb-96	86
LA-32-05-06	04-Feb-96	08-Feb-96	97
LA-33-02-04	15-Feb-96	19-Feb-96	94
LA-33-04-06	15-Feb-96	19-Feb-96	96
LA-34-00-04	09-Feb-96	12-Feb-96	95
LA-34-00-04D	09-Feb-96	12-Feb-96	100
LA-34-94-08	09-Feb-96	12-Feb-96	100
LA-35-02-04	15-Feb-96	19-Feb-96	97
LA-35-04-06	15-Feb-96	19-Feb-96	94
LA-36-00-04	03-Feb-96	06-Feb-96	100
LA-36-00-04D	03-Feb-96	07-Feb-96	99
LA-36-04-08	03-Feb-96	07-Feb-96	97
LA-37-03-05	11-Feb-96	14-Feb-96	93
LA-37-05-07	11-Feb-96	14-Feb-96	94
LA-38-05-06	03-Feb-96	07-Feb-96	98
LA-38-11-12	03-Feb-96	07-Feb-96	96
LA-39-00-02	11-Feb-96	14-Feb-96	119
LA-39-06-08	11-Feb-96	14-Feb-96	99
LA-40-00-03	07-May-96	14-May-96	61
LA-40-00-03	04-Feb-96	08-Feb-96	108
LA-40-00-04 RE	05-Feb-96	10-Feb-96	150
LA-40-08-09	04-Feb-96	08-Feb-96	97
LA-41-02-04	13-Feb-96	16-Feb-96	103
LA-41-06-08	13-Feb-96	16-Feb-96	106
LA-42-00-04	07-Feb-96	10-Feb-96	134
LA-42-00-04	07-May-96	14-May-96	106
LA-42-00-04 DUP.	07-May-96	14-May-96	116
LA-42-00-04D	07-Feb-96	10-Feb-96	123
LA-42-08-12	07-Feb-96	10-Feb-96	108
LA-43-04-06	15-Feb-96	19-Feb-96	128

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Table 3-5 ABB-ES Wakefield Laboratory Quality Control Results-Surrogate Recovery

Sample ID	Date Sampled	Date Analyzed	Para-terphenyl Recovery (%Rec)
LA-43-06-08	15-Feb-96	19-Feb-96	98
LA-44-04-08	07-Feb-96	10-Feb-96	123
LA-44-08-12	07-Feb-96	10-Feb-96	125
LA-44-08-12	07-May-96	15-May-96	93
LA-45-04-06	13-Feb-96	17-Feb-96	98
LA-45-06-08	13-Feb-96	17-Feb-96	97
LA-46-03-04	02-Feb-96	05-Feb-96	99
LA-46-03-04D	02-Feb-96	05-Feb-96	96
LA-46-03-04MSD		05-Feb-96	85
LA-46-09-10	02-Feb-96	05-Feb-96	97
LA-47-00-02	11-Feb-96	15-Feb-96	104
LA-47-00-03	15-Feb-96	20-Feb-96	99
LA-47-05-07	11-Feb-96	15-Feb-96	97
LA-48-02-03	03-Feb-96	07-Feb-96	87
LA-48-07-08	03-Feb-96	07-Feb-96	98
LA-49-00-02	11-Feb-96	15-Feb-96	177
LA-49-02-04	11-Feb-96	15-Feb-96	125
LA-50-00-04	03-Feb-96	07-Feb-96	79
LA-50-06-07	03-Feb-96	07-Feb-96	91
LA-51-02-04	13-Feb-96	17-Feb-96	114
LA-51-06-08	13-Feb-96	17-Feb-96	102
LA-52-00-04	03-Feb-96	07-Feb-96	103
LA-52-08-12	03-Feb-96	07-Feb-96	96
LA-52-08-12D	03-Feb-96	07-Feb-96	97
LA-53-04-08	13-Feb-96	16-Feb-96	109
LA-53-08-10	13-Feb-96	16-Feb-96	114
LA-53-10-12	13-Feb-96	16-Feb-96	105
LA-53-10-12D	13-Feb-96	16-Feb-96	97
LA-54-03-04	03-Feb-96	07-Feb-96	105
LA-54-11-12	03-Feb-96	07-Feb-96	104
LA-56-02-04	07-Feb-96	12-Feb-96	104
LA-56-04-06	07-Feb-96	12-Feb-96	103
LA-57-02-04	08-Feb-96	12-Feb-96	101
LA-57-04-06	08-Feb-96	13-Feb-96	102
LA-58-02-04	08-Feb-96	13-Feb-96	101
LA-58-04-06	08-Feb-96	13-Feb-96	101
LA-60-02-04	08-Feb-96	13-Feb-96	100
LA-60-04-06	08-Feb-96	13-Feb-96	99
LA-61-02-04	08-Feb-96	13-Feb-96	95
LA-61-04-06	08-Feb-96	13-Feb-96	103
LA-62-00-02	12-Feb-96	18-Feb-96	118
LA-62-92-94	12-Feb-96	18-Feb-96	97
LA-64-02-04	12-Feb-96	16-Feb-96	97
LA-65-02-04	12-Feb-96	16-Feb-96	109
LA-67-00-02	12-Feb-96	16-Feb-96	106
LA-67-02-04	12-Feb-96	16-Feb-96	108
LA-68-05-06	14-Feb-96	21-Feb-96	99
LA-72-00-02	14-Feb-96	21-Feb-96	95
LA-72-02-04	14-Feb-96	21-Feb-96	97
LA-72-02-04D	14-Feb-96	22-Feb-96	91
LA-73-00-02	15-Feb-96	20-Feb-96	90
LA-73-02-04	15-Feb-95	20-Feb-96	101
LA-74-02-04	15-Feb-96	20-Feb-96	94
LA-75-00-02	15-Feb-96	20-Feb-96	129
LA-75-00-02	07-May-96	13-May-96	62
LA-75-04-06	15-Feb-96	20-Feb-96	91
LA-75-04-06	07-May-96	14-May-96	96
LA-76-00-02	15-Feb-96	19-Feb-96	106
LA-76-00-02	07-May-96	13-May-96	115
LA-76-02-04	15-Feb-96	19-Feb-96	97
LA-77-00-02	15-Feb-96	19-Feb-96	107
LA-77-02-04	07-May-96	15-May-96	96
LA-77-02-04	15-Feb-96	20-Feb-96	92
LA-77-02-04 MS	07-May-96	15-May-96	99
LA-77-02-04 MSD	07-May-96	15-May-96	97
LA-78-00-02	15-Feb-96	20-Feb-96	100
LA-79-08-10	15-Feb-96	20-Feb-96	94
LA-79-10-12	15-Feb-96	20-Feb-96	95
LA-80-00-02	15-Feb-96	20-Feb-96	109

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Table 3-5 ABB-ES Wakefield Laboratory Quality Control Results-Surrogate Recovery

Sample ID	Date Sampled	Date Analyzed	Para-terphenyl Recovery (%Rec)
LA-80-00-02	08-May-96	15-May-96	99
LA-80-00-02D	08-May-96	15-May-96	101
LA-81-00-02	15-Feb-96	20-Feb-96	115
LA-83-04-06	07-May-96	15-May-96	93
LA-83-04-06	16-Feb-96	21-Feb-96	100
LA-84-06-08	16-Feb-96	21-Feb-96	98
LA-84-06-08D	16-Feb-96	22-Feb-96	97
LA-85-02-04	15-Feb-96	20-Feb-96	98
LA-86-00-02	16-Feb-96	20-Feb-96	101
LA-87-00-02	16-Feb-96	21-Feb-96	101
LA-88-02-04	16-Feb-96	21-Feb-96	102
LA-89-00-02	16-Feb-96	21-Feb-96	101
LA-92-02-04	16-Feb-96	21-Feb-96	99
LA-93-04-06	16-Feb-96	21-Feb-96	93
LA-93-04-06D	16-Feb-96	21-Feb-96	91
LA-94-02-04	16-Feb-96	21-Feb-96	99
LA-95-02-04	16-Feb-96	21-Feb-96	92
LA-96-00-02	08-May-96	16-May-96	68
LA-96-00-02	16-Feb-96	21-Feb-96	101
LA-97-00-02	16-Feb-96	21-Feb-96	101
LA-98-02-04	16-Feb-96	21-Feb-96	91
LA-99-00-02	07-May-96	15-May-96	95
LA-99-00-02	16-Feb-96	21-Feb-96	99
SA-01-00-04	06-Feb-96	09-Feb-96	119
SA-01-00-04	07-May-96	13-May-96	100
SA-01-04-08	06-Feb-96	09-Feb-96	95
SA-01-04-08	07-May-96	13-May-96	101
SA-01-04-08D	06-Feb-96	09-Feb-96	94
SA-02-00-02	11-Feb-96	15-Feb-96	133
SA-02-02-04	11-Feb-96	15-Feb-96	99
SA-02-02-04D	11-Feb-96	15-Feb-96	97
SA-03-00-04	06-Feb-96	08-Feb-96	96
SA-03-04-08	06-Feb-96	08-Feb-96	93
SA-04-00-02	11-Feb-96	14-Feb-96	100
SA-04-02-04	11-Feb-96	14-Feb-96	99
SA-05-00-02	11-Feb-96	14-Feb-96	95
SA-05-02-04	11-Feb-96	15-Feb-96	102
SA-05-02-04D	11-Feb-96	15-Feb-96	102
SA-06-00-04	06-Feb-96	09-Feb-96	93
SA-06-08-12	06-Feb-96	09-Feb-96	91
SA-06-08-12D	06-Feb-96	09-Feb-96	93
SA-07-00-02	11-Feb-96	15-Feb-96	102
SA-07-02-04	11-Feb-96	15-Feb-96	90
SA-08-00-04	06-Feb-96	08-Feb-96	94
SA-08-08-12	06-Feb-96	08-Feb-96	96
SA-09-00-04	06-Feb-96	08-Feb-96	98
SA-09-00-04 RE	06-Feb-96	10-Feb-96	105
SA-09-08-12	06-Feb-96	08-Feb-96	94
SA-10-02-04	13-Feb-96	17-Feb-96	105
SA-10-04-08	07-Feb-96	09-Feb-96	103
SA-10-06-08	13-Feb-96	17-Feb-96	103
SA-11-00-04	06-Feb-96	08-Feb-96	82
SA-11-08-12	06-Feb-96	09-Feb-96	94
SA-12-00-02	11-Feb-96	15-Feb-96	101
SA-12-02-04	11-Feb-96	15-Feb-96	99
SA-13-02-04	07-May-96	13-May-96	103
SA-13-02-04	15-Feb-96	19-Feb-96	95
SA-13-06-08	15-Feb-96	19-Feb-96	92
SA-13-06-08	07-May-96	10-May-96	103
SA-14-04-08	07-Feb-96	09-Feb-96	104
SA-14-08-12	06-Feb-96	09-Feb-96	102
SA-15-02-04	13-Feb-96	17-Feb-96	98
SA-15-02-04D	13-Feb-96	17-Feb-96	99
SA-15-06-08	13-Feb-96	17-Feb-96	99
SA-16-00-04	06-Feb-96	08-Feb-96	98
SA-16-08-12	06-Feb-96	08-Feb-96	96
SA-17-04-08	06-Feb-96	09-Feb-96	97
SA-17-08-12	06-Feb-96	09-Feb-96	94
SA-18-02-04	13-Feb-96	17-Feb-96	135

Table 3-5 ABB-ES Wakefield Laboratory Quality Control Results-Surrogate Recovery

Sample ID	Date Sampled	Date Analyzed	Para-terphenyl Recovery (%Rec)
SA-18-06-08	13-Feb-96	17-Feb-96	107
SA-19-00-04	07-Feb-96	09-Feb-96	107
SA-19-00-04	07-Feb-96	09-Feb-96	107
SA-19-00-04 MS	07-Feb-96	09-Feb-96	98
SA-19-00-04 MSD	07-Feb-96	09-Feb-96	98
SA-19-00-04D	07-Feb-96	09-Feb-96	97
SA-20-00-02	11-Feb-96	15-Feb-96	99
SA-20-02-04	11-Feb-96	15-Feb-96	97
SA-21-00-02	11-Feb-96	15-Feb-96	103
SA-21-02-04	11-Feb-96	15-Feb-96	99
SA-22-00-04	05-Feb-96	08-Feb-96	95
SA-22-08-12	05-Feb-96	08-Feb-96	95
SA-23-00-02	11-Feb-96	15-Feb-96	97
SA-23-02-04	11-Feb-96	15-Feb-96	99
SA-24-00-04	06-Feb-96	09-Feb-96	91
SA-24-08-12	06-Feb-96	09-Feb-96	96
SA-25-00-02	14-Feb-96	22-Feb-96	100
SA-25-00-02D	16-Feb-96	22-Feb-96	99
SA-25-04-08	13-Feb-96	22-Feb-96	95
SA-26-02-04	13-Feb-96	22-Feb-96	100
SA-27-00-02	12-Feb-96	16-Feb-96	105
SA-27-02-04	12-Feb-96	16-Feb-96	105
SA-28-08-9.5	11-Feb-96	16-Feb-96	104
SA-29-03-04	16-Feb-96	22-Feb-96	127
SA-29-04-08	16-Feb-96	22-Feb-96	97
SA-30-00-02	15-Feb-96	20-Feb-96	103
SA-30-00-02	08-May-96	16-May-96	108
SA-30-02-04	15-Feb-96	20-Feb-96	91
SA-31-00-02	13-Feb-96	22-Feb-96	101
SA-31-02-04	13-Feb-96	22-Feb-96	95
SA-32-00-02	15-Feb-96	19-Feb-96	92
SA-32-00-02	08-May-96	16-May-96	98
SA-32-02-04	15-Feb-96	19-Feb-96	96
SA-32-02-04	08-May-96	15-May-96	97
SA-33-00-02	14-Feb-96	22-Feb-96	97
SA-34-00-04	14-Feb-96	18-Feb-96	93
SA-34-06-08	14-Feb-96	18-Feb-96	95
SA-35-02-04	14-Feb-96	18-Feb-96	101
SA-35-06-08	14-Feb-96	18-Feb-96	98
SA-36-00-02	14-Feb-96	18-Feb-96	144
SA-36-03-04	14-Feb-96	18-Feb-96	101
SC-02-00-02	08-May-96	16-May-96	106
SC-02-00-04	05-Feb-96	08-Feb-96	98
SC-02-04-08	05-Feb-96	08-Feb-96	92
SD-13-06-08	07-May-96	13-May-96	97

RANGE	61-189
AVERAGE	100.73
Standard Deviation	12.02

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3.6 Geotechnical Analysis

Twenty-five percent of the samples taken from the Lagoon and Scraped Area were evaluated for grainsize distribution and TOC. All Drainage Swale samples were analyzed for these parameters and also percent solids. The TOC results are presented in Table 3-6 along with the corresponding cPAH result. Grainsize results are contained in Appendix C. (Note: samples which were contaminated to the extent that tar or oil would interfere with grainsize results were not evaluated as to grainsize distribution.).

TOC values varied widely between samples, as seen in the following summary:

- Drainage Swales: minimum 580 mg/kg to maximum 68,000 mg/kg
- Lagoon Area: minimum 940 mg/kg to maximum 89,000 mg/kg
- Scraped Area: minimum 1,700 mg/kg to maximum 50,000 mg/kg

There did not appear to be a correlation between TOC value and cPAH result.

Grainsize analyses revealed that the subsurface soils in the he Lagoon and Scraped Area are primarily silt and clay (i.e. have a high percent of fines). Cobbles larger than 3/4-inch diameter were rarely observed. Drainage Swale soils were found to be primarily sand and silt.

Sediment samples were analyzed for percent solids. The range of percent solids observed in these samples was 40 to 81 %. The results of the sediment solids analyses are presented in Table 3-7.

These grainsize results will be utilized during the bioremediation treatment system design to determine process and equipment needs. They will also affect the design of excavation systems for the Drainage Swales, because of the effect of soil type on resuspension and aqueous transport of particles.

TOC results will affect the evaluation of biological treatment. For example, high TOC concentrations may indicate an abundance of organic matter (natural or otherwise) that will affect oxygen consumption rates (i.e., necessary frequency of tilling) in a land treatment system. One of the goals of field pilot testing will be to determine oxygen consumption rates.

Table 3-6: Total Organic Carbon Results

Sample Id	TOC[4] (mg/kg)	cPAH[1,2] (mg/kg)	cPAH/ TOC ratio (%)	Soil Classification (as determined by grainsize analysis)
DS1-01	13,000	141	1.1	silt, some clay
DS1-02	38,000	6	0.02	silt, little fine sand; organic material in sample
DS1-03	14,000	2,121	15.2	insufficient sample volume to conduct grainsize analysis
DS1-04	25,000	1,686	6.7	trace coarse sand, tar adhered to pan
DS1-05	25,000	57	0.2	fine to coarse sand, some silt
DS1-06	580	267	46.1	fine to coarse sand, some silt; organic material in sample
DS1-07	68,000	286	0.4	silt, little sand; organic material in sample
DS1-08	43,000	262	0.6	silt, little clay, gravel and sand
DS1-09	28,000	9	0.03	silt, some clay, little fine sand
DS1-10	31,000	70	0.2	silt, little clay and sand; organic material in sample
DS1-11	19,000	8	0.04	fine gravel to fine sand, some silt
DS1-12	17,000	2	0.01	fine to coarse sand, some silt
DS1-13-00-0.5	33,000	6,900	20.9	insufficient sample volume to conduct grainsize analysis
DS1-13-01-02	5,000	2	0.03	silt, some clay, little fine sand
DS1-14-00-0.5	16,000	27,826	173.9	tar content of soil sample interfered with grainsize analysis, analysis not conducted
DS1-14-01-02	4,700	2	0.03	clayey silt, little fine sand
DS1-15-01-02	8,700	2	0.02	clayey silt, trace sand and fine gravel
DS1-15-01-02 D	6,300	2	0.02	clayey silt, trace sand
DS1-15-02-04	2,600	2	0.1	silt, some clay, little fine gravel
DS1-16-00-0.5	8,900	8,331	93.6	tar content of soil sample interfered with grainsize analysis, analysis not conducted
DS1-16-01-02	15,000	7	0.05	insufficient sample volume to conduct grainsize analysis
DS1-17-01-02	9,600	2	0.02	silt, some clay
DS1-17-02-04	4,700	2	0.03	silt, some clay, little fine sand
DS1-18-01-02	7,600	2	0.02	clayey silt, trace sand
DS1-18-02-04	1,500	2	0.1	clayey silt, trace sand and gravel
DS2-01	5,000	20	0.4	fine to coarse sand, some silt
DS2-02	5,000	65	1.3	coarse to fine sand, some gravel and silt
DS2-03	9,600	50	0.5	fine to coarse sandy silt, little clay
DS2-04	3,600	47	1.3	fine to coarse sand, some silt and fine gravel
DS2-05	3,800	2	0.04	fine gravel, some silt, little clay and sand
DS2-06	11,000	2	0.01	fine to coarse sandy silt, little clay
DS2-07	2,900	57	2.0	coarse to fine sand, some gravel and little silt
DS2-07 D	9,000	49	0.5	coarse to fine sand, some silt and fine gravel
DS2-08	10,000	11	0.1	fine to coarse sand, some silt, little fine gravel
DS2-09	8,800	3	0.03	fine to coarse sand, some silt
DS2-10	8,900	4	0.04	fine to coarse sand, some silt, little fine gravel and clay
DS3-01	26,000	4	0.01	fine to coarse sand, some silt; appears to be peat
DS3-02	17,000	220	1.3	coarse to fine sand, some silt; appears to be peat
DS3-03	47,000	67	0.1	silty sand; organic material in sample
DS3-04	34,000	26	0.1	silt, some clay, little sand
DS3-05	8,800	29	0.3	fine to coarse sand, little silt; organic material in sample
DS3-06	17,000	15	0.1	fine to coarse sand, some gravel and silt; organic material in sample
LA-02-00-04	42,000	95	0.2	coarse to fine sand, trace silt; tar adhered to pan *black sandy silt
LA-07-00-02	14,000	94	0.7	*silty clay mixed with black ash/grit
LA-07-02-04	22,000	2	0.0	*silty clay mixed with black ash/grit
LA-08-04-08	12,000	263	2.2	coarse to fine gravel, some silt; large pieces of tar in sample *black ash/grit
LA-13-02-04	55,000	21,485	39.1	*silty clay with black ash/grit
LA-17-00-02	5,800	18	0.3	fine to coarse sand, some fine gravel *black ash/grit
LA-17-00-02 D	12,000	87	0.7	*black ash/grit
LA-19-00-02	940	71	7.6	silt, trace sand *some black ash/grit
LA-22-00-04	8,400	NA	NA	*visible tar, black ash/grit
LA-22-04-08	3,700	73	2.0	clay, trace sand and fine gravel
LA-23-02-04	12,000	15	0.1	fine to coarse sand, some silt *black ash/grit
LA-24-00-04	30,000	NA	NA	*visible tar, black ash/grit
LA-25-00-02	24,000	2,496	10.4	*visible tar, black ash/grit
LA-26-00-04	52,000	NA	NA	*black ash/grit
LA-27-00-02	89,000	36	0.04	*black ash/grit

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Table 3-6: Total Organic Carbon Results (continued)

Sample Id	TOC[1] (mg/kg)	cPAH[1,2] (mg/kg)	cPAH/TOC ratio (%)	Soil Classification (as determined by grainsize analysis)
LA-30-00-02	38,000	262	0.7	fine to coarse **sand**, little fine gravel and silt *black ash/grit
LA-31-04-06 D	2,100	188	9.0	**silt**, trace fine gravel and sand *black ash/grit
LA-34-00-04	22,000	2	0.01	fine to coarse **sand**, some silt and fine gravel; black charcoal pieces
LA-37-03-05	1,700	2	0.1	**clay**, trace sand and fine gravel *organic matter
LA-38-03-04	4,500	NA	NA	**silt**, some coarse gravel, little sand; large charcoal pieces
LA-38-05-06	9,200	109	1.2	**clay**, trace sand and fine gravel *black ash/grit
LA-40-00-03	21,000	12,471	59.4	*visible tar, black ash/grit
LA-41-02-04	68,000	2	0.002	fine to coarse sandy **silt**, little fine gravel; black charcoal pieces
LA-42-00-04	40,000	2,800	7.0	*visible tar, black ash/grit
LA-42-04-08	18,000	NA	NA	fine to coarse **sand**, little fine gravel and silt; tar adhered to pan
LA-43-04-06	16,000	4,982	31.1	*visible tar
LA-43-06-08	4,800	169	3.5	**silt/clay**, trace sand and gravel
LA-44-00-04	13,000	NA	NA	*visible tar, black ash/grit
LA-44-04-08	6,700	313	4.7	**clay**, trace sand *visible tar
LA-44-08-12	13,000	681	5.2	coarse to fine sandy **gravel**, little silt *visible tar
LA-45-04-06	27,000	5	0.02	*black ash/grit
LA-46-09-10	2,800	7	0.3	**clay**, trace sand
LA-48-02-03	28,000	65	0.2	**silt/clay**, trace sand and gravel
LA-49-00-02	45,000	4,415	9.8	**silt**, little sand and fine gravel * black ash/grit
LA-49-02-04	11,000	1,456	13.2	**silt**, trace fine gravel and sand; entire sample composed of ash/charcoal
LA-50-00-04	52,000	91	0.2	fine to coarse **sand**, little fine gravel and silt *black ash/grit
LA-51-02-04	35,000	1,127	3.2	fine to coarse **sand**, little fine gravel and silt; black tar in sample *black ash/grit
LA-53-04-08	19,000	1,157	6.1	fine to coarse **sand**, some silt and fine gravel
LA-53-08-10	49,000	1,500	3.1	**silt**, little sand; black tar in sample
LA-54-03-04	89,000	2,956	3.3	*visible tar, black ash/grit
LA-62-00-02	5,300	782	14.7	coarse to fine sandy **gravel**, little silt/clay *black organic matter
LA-62-02-04	37,000	2	0.004	**silt**, trace fine gravel and sand *black organic matter
LA-68-05-06	1,200	41	3.4	**silt/clay**, some fine gravel
LA-74-00-02	25,000		0.0	**silt/clay**, little fine gravel and sand
LA-76-00-02	4,300	554	12.9	*black ash/grit
LA-76-02-04	1,800	2	0.1	*silty clay
LA-83-04-06	19,000	4	0.02	*black ash/grit
LA-96-00-02	10,000	3,118	31.2	*black ash/grit
SA-01-00-04	12,000	812	6.8	*black ash/grit and organic material
SA-02-00-02	32,000	1,986	6.2	coarse to fine **gravel**, some silt; black charcoal pieces and tar *black ash/grit, organic material
SA-02-02-04	15,000	2	0.01	**silt**, little fine gravel; large black charcoal pieces *black organic matter
SA-03-00-04	12,000	2	0.01	**silt/clay**, trace sand and gravel
SA-06-00-04	25,000	2	0.01	**silt**, trace sand with small amount of organic material
SA-11-00-04	13,000	36	0.3	coarse to fine **gravel**, little silt; large black charcoal pieces
SA-14-00-04	50,000	NA	NA	coarse to fine sandy fine **gravel**, little silt; black charcoal pieces and tar *black ash/grit
SA-16-00-04	33,000	131	0.4	coarse to fine **gravel**, trace silt; large black charcoal pieces and tar
SA-17-00-04	11,000	NA	NA	**silt**, trace sand and gravel *black ash/grit
SA-19-00-04	10,000	2	0.02	**silt**, trace sand and gravel
SA-21-00-02	15,000	2	0.01	*silty clay, black ash/grit
SA-21-02-04	1,700	2	0.1	**silt/clay**, trace sand and gravel
SA-23-00-02	10,000	22	0.2	**silt**, trace sand with organic material
SA-23-02-04	5,700	2	0.03	*silty clay
SA-29-03-04	30,000	353	1.2	*silty clay, black ash/grit
SA-34-00-04	50,000	16	0.03	fine **gravel**, little silt and sand; large charcoal pieces
SA-35-02-04	15,000	4	0.02	*silty clay, black ash/grit
SA-36-03-04	1,600	2	0.1	*black ash/grit
SC-02-00-04	43,000	105	0.2	fine to coarse gravel silt
SC-02-04-08	5,000	2	0.03	**clay**, trace sand and fine gravel

1: all results from samples taken during Feb. 1996 sampling event

2: for calculation purposes, non-detect samples were assign a value equal to one-half detection limit (i.e. 2 mg/kg)

*: comments taken from boring logs and analytical lab observation sheets

NA: not analyzed

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Table 3-7: Percent Solids

Sample ID	Date Sampled	Percent Solids
DS1-01	10-Feb-96	63
DS1-02	10-Feb-96	66
DS1-03	10-Feb-96	69
DS1-03D	10-Feb-96	67
DS1-04	10-Feb-96	57
DS1-05	10-Feb-96	68
DS1-06	10-Feb-96	62
DS1-07	10-Feb-96	40
DS1-08	10-Feb-96	48
DS1-09	10-Feb-96	63
DS1-10	10-Feb-96	51
DS1-11	10-Feb-96	65
DS1-11D	10-Feb-96	65
DS1-12	10-Feb-96	69
DS1-13-00-0.5	14-Feb-96	68
DS1-13-01-02	14-Feb-96	74
DS1-14-00-0.5	14-Feb-96	80
DS1-14-01-02	14-Feb-96	78
DS1-15-01-02	14-Feb-96	77
DS1-15-01-02D	14-Feb-96	79
DS1-15-02-04	14-Feb-96	81
DS1-16-00-0.5	14-Feb-96	79
DS1-16-01-02	14-Feb-96	75
DS1-17-01-02	14-Feb-96	73
DS1-17-02-04	14-Feb-96	79
DS1-18-01-02	14-Feb-96	78
DS1-18-02-04	14-Feb-96	79
DS2-01	10-Feb-96	79
DS2-02	10-Feb-96	79
DS2-03	10-Feb-96	71
DS2-04	10-Feb-96	74
DS2-05	10-Feb-96	77
DS2-06	10-Feb-96	71
DS2-07	10-Feb-96	78
DS2-07 DUP	10-Feb-96	77
DS2-08	09-Feb-96	75
DS2-10	09-Feb-96	60
DS2-9	09-Feb-96	75
DS3-01	09-Feb-96	31
DS3-01D	09-Feb-96	32
DS3-02	09-Feb-96	47
DS3-03	09-Feb-96	47
DS3-04	09-Feb-96	62
DS3-05	09-Feb-96	60
DS3-06	09-Feb-96	52

4.0 DISCUSSION OF RESULTS

4.1 Visual Indications of Tar

Tar residues were found mainly in the Lagoon Area, with some in the Scraped Area. Within either area, random locations of tar were apparent. These observations suggest random, occasional disposal. ABB-ES observed the tar in some areas, such as in the upper reaches of Drainage Swale #1, to be a thin crust on the land surface, underlain by clean soil.

4.2 Types of material

ABB-ES observed many physical characteristics of the contaminated soil materials that will require removal and treatment/disposal, including the following:

- Clay and silty clay soils with dark staining and odors. Although these underlying soils demonstrate relatively low concentrations of cPAHs compared to soils saturated with liquid tar, those that are above the cPAH target will likely form the largest treatment category in terms of volume. Some soils contained staining in the form of discrete globules, while others contained seams of tar or other black substances. Samples often exhibited a characteristic tar odor, but many stained soils had undefined odors or no detectable odor. Because of the low odor threshold of tar, visible tar is normally accompanied by tar odors. Therefore, stained soils which did not exhibit a characteristic tar odor may have contained other waste materials.

- Tar mixed with backfill: often saturated with tar.

- Tar as a distinct layer: rarely found, of two principal forms-hard and brittle, or "toothpaste" consistency.

- Ash: Very often encountered near the land surface, often mixed with tar.

Another physical feature observed, is that in over 100 borings, the only locations where the GeoProbe hit refusal were those where clean pieces of sandstone bedrock came up in the sampling tube. This observation supports the RI/FS observation of no buried objects such as drums or demolition debris. However, implementation plans should provide screening and crushing capability because no sampling program can completely exclude the possibility of undetected buried objects.

The Lagoon Area grid was expanded nearly 2-fold, from the original 54 nodes to 103 sampling nodes. This expansion was predominantly to the south and west. The need to extend the Lagoon Area grid so far to the south and west reveals one flaw in the RI/FS: all test pits in that area had been reported to be below target cPAH concentrations. Accordingly, the aerial extent of excavation (plan view) in the Lagoon Area will probably exceed the estimates made earlier by EPA contractors. On the other hand, the depths of contamination appear to be less than previous estimates. A similar trend caused the Scraped Area grid to require extension to the north and south, but to a much lesser extent than for the Lagoon Area. Another finding in the Scraped Area is a thin layer of tar near the top of a pile of soil and rubble in the southwest part of the Scraped Area.

4.3 Metals

This field effort confirmed those metals results presented in the Remedial Investigation/Feasibility Study Report (Roy F. Weston 1988) which indicate that metal contaminants of concern are generally not found above the ROD-specified action levels at the Site. The RI/FS metals data reported exceedances at only two sampling locations out of more than one hundred sampling locations. This 1996 field effort found no soil with metals concentrations above the ROD-specified action levels in the ten samples taken from the two locations that were suspected to have elevated soil metals concentrations.

4.4 cPAHs

This field effort confirmed the Weston RI/FS and the ROD findings that several thousand cubic yards of soil and waste materials, primarily from the Lagoon Area, are above action levels for cPAHs. Because of a more precise sampling approach emphasizing grab samples at discrete depths, the recent field work improved knowledge regarding the locations of soils requiring remedial action. While some common locations were identified in both the 1996 and 1988 efforts, the 1996 work showed that some areas previously believed clean will require additional action. These areas are in the southern and western parts of the Lagoon Area and in the northern and southern parts of the Scraped Area. Conversely, the discrete samples taken from greater depths (generally deeper than 6 feet) will not require action, with few exceptions. The earlier work, based on composites from test pits of 8 to 12 foot depth, assumed that the entire depth was contaminated if the composite result was above cPAH action levels.

4.5 cPAH Distribution/Excavation Volume Estimates

For the Lagoon Area and the Scraped Area, volumes of soil above action levels were estimated using the following protocol:

1. Subdivide the area in plan view based on frequency of contaminated samples and similar depths of contamination. For each sub-area:
2. Assume a depth of excavation one foot lower than the deepest contaminated interval for any sample in that sub-area.
3. Assume a perimeter of excavation 15 feet outside the perimeter of each sub-area of contaminated sample points, to allow for slopes in the trenches and to provide a conservative estimate.

Detailed maps are provided in Appendix F.

4.5.1 Lagoon Area

The Lagoon Area excavation volume calculations resulted in an estimate of approximately 10,000 cubic yards (cy) of soil above action levels. A summary of the sub-areas and the results is as seen in Table 4-1. While some of the contaminated areas delineated in this field effort overlap with the areas assumed in the EPA RI/FS, the contaminated areas discovered to the south and west of the initial grid which will require treatment differ from where earlier reports by EPA contractors suggested soil requiring treatment was located. The reason for this effort's finding of soils above target concentrations in areas where the earlier RI/FS data suggested clean soils were present is likely due to different sampling techniques. This recent effort used grab samples from borings, while earlier efforts relied primarily on composite samples from test pits. The earlier composites may have contained enough clean soil to dilute the cPAHs below action levels.

Table 4-1: Lagoon Area, Excavation Sub-areas

Sub-area	Plan View Area (sq.ft)	Average Depth (ft)	Estimated Volume (cy)
A	5,400	4	800
B	14,400	6	3,200
C	3,600	4	533
D	5,400	12	2,400
E	7,200	6	1,600
F	8,100	3	900
G	11,700	3	1,300
Total Estimated Volume			**10,733**

4.5.2 Scraped Area

The Scraped Area excavation volume calculations resulted in an estimate of approximately 2,200 cy, also in unexpected locations (locations different from where earlier reports by EPA contractors indicated contamination was present), for the same reasons as described above. . A summary of the sub-areas and the results is as seen in Table 4-2.

Table 4-2: Scraped Area, Excavation Sub-areas

Sub-area	Plan View Area (sq ft)	Average Depth (ft)	Estimated Volume (cy)
A	4,500	5	833
B	900	5	167
C	2,700	5	1000
D	900	2	67
E	800	2	177
Total Estimated Volume			**2,244**

4.5.3 Drainage Swales

The Drainage Swale excavation volume calculations resulted in an estimate of approximately 200 to 300 total cy of soil above action levels in the three swales, as indicated in Section 4.0. . A summary of the results are presented in Table 4-3. For the Drainage Swales, an estimate was made of the linear feet of swale above action levels, and this was converted to volume by assuming an average 5 foot width and one foot depth of excavation.

Table 4-3: Drainage Swales, Excavation Sub-areas

Area	Number of Sub-areas	Range of Length (lin.ft)	Average Depth (ft)	Estimated Volume (cy)
Swale #1	1	900	1	167
Swale #3	1	200	1	37

5.0 WETLANDS DELINEATION

Wetlands delineation will serve two purposes. It will assist in the process of cap design by alerting engineers to the precise boundaries of wetlands in areas that may be affected by the landfill cap. With this knowledge, engineers can configure the cap to minimize wetland impacts. The second purpose relates to remediation of Drainage Swales. The ROD includes Drainage Swales in the materials planned for bioremediation. Dredging these sediments will involve heavy equipment working in the wetlands, both for excavating and transporting contaminated sediments. Knowledge of the wetland boundaries will help designers to minimize wetland impacts resulting from this remedial activity.

Wetlands delineation activities were conducted on April 11 and 12, 1996. ABB-ES identified and delineated on-site federal jurisdictional wetlands subject to regulation by the U.S. Army Corps of Engineers (USCOE). Wetlands were delineated according to the prescribed procedures specified in the *Corps of Engineers Wetlands Delineation Manual*, Technical Report Y-87-1, dated January 1987. Wetland areas were marked in the field and were subsequently surveyed and incorporated into the Site map developed by Law Environmental. The wetlands map is included in Appendix A.

Following review of appropriate information sources (including the Marion and Monongalia Counties Soil Survey maps, National Wetland Inventory and topographic maps), the presence of jurisdictional wetlands associated with Morgantown OU1 property were determined during a site walkover by an ABB-ES wetland biologist and Richard Sobol of the U.S. Army Corps of Engineers (USCOE) on 12 April 1996. A single jurisdictional wetland associated with the landfill in the northeastern portion of the property was identified. Although additional wet areas were encountered during the site walkover, these other habitats are primarily intermittent drainages that lack one or more wetland attributes. It was concluded that no other jurisdictional wetlands exist at, or immediately downgradient of, the property. The palustrine wetland located within the fenced area at OU1 is contiguous with a narrow wetland area adjacent to Drainage Swale #3 (Figure 3-1) that continues to the railroad tracks. Dominant vegetation associated with this wetland include red maple (*Acer rubrum*), black willow (*Salix niger*), and spicebush (*Lindera benzoin*).

The identified wetland was delineated and field-flagged according to the prescribed procedures specified in the Corps of Engineers Wetland Delineation Manual, Technical Report Y-87-1, dated January 1987. Three transects were located along the jurisdictional wetland and USCOE wetland delineation data sheets were completed for observation plots on either side of the boundary in accordance with the federal manual. Two sets of observation plots were established at the most upgradient transect due to the width of the wetland in the vicinity of the landfill. The portion of the wetland that lies within the fence was field-flagged with flags A-1 through A-20, flags B-1 through B-15 delineate the portion of the wetland associated with Drainage Swale #3. Based on survey results, this wetland is approximately 0.55 acres in extent.

The presence of this wetland adjacent to the landfill area and encompassing the majority of Drainage Swale #3 will primarily affect the design of the landfill cap, due to the close proximity of the wetland to the eastern edge of the landfill. Capping activities are highly likely to result in impacts to the western portion of wetland.

Results of the sampling in Drainage Swale #3 revealed relatively low levels of cPAH contamination in the majority of sampling locations. It is likely that only very limited portions of the upper reach of this swale will require remediation (i.e. excavation). As a result, the impacts to the wetland from Drainage Swale remediation activities are not expected to be extensive.

6.0 FENCE INSTALLATION AND DRUM REMOVAL

Response actions conducted at OU1 concurrently with Pre-design Sampling included removal and proper disposal of drums containing IDW from former sampling activities at OU1 and installation of a security fence around the perimeter of OU1.

The removal and proper disposal of drums containing IDW and installation of a security fence was arranged directly by Olin. Thirteen drums were present at OU1 prior to their removal in February 1996. These drums contained soil, water or personal protective equipment (PPE) from former investigatory activities sponsored by EPA.

6.1 Drum Removal

Removal of drums of IDW was conducted. The drums were appropriately overpacked, labeled, removed from the site, and transported under Olin's direction to an appropriate disposal location by the subcontractor. Appendix G contains copies of "certificates of destruction" for the drum removed from the site. It also contains the two shipping manifests: one signed by EPA for drums left behind by its contractors in 1987, and one signed by Olin for IDW generated in this 1996 field program.

6.2 Fence Installation

The perimeter fence was designed and constructed to keep trespassers away from areas of concern at OU 1. This action will not only reduce the likelihood of exposure to chemicals for the trespassers themselves, but will also reduce or eliminate the "tracking" of contaminated soils to off-site locations by pedestrians and vehicles.

The fence is 3,197 feet long and consists of 11 gauge galvanized chain link, 6 feet high. Three strands of barbed wire discourage access over the top. Locked double drive gates, each 12 feet wide, provide vehicle access.

7.0 SUMMARY OF RESULTS

7.1 FIELD OBSERVATIONS

7.1.1 Soil Types and Visual Indications of Contamination

Soil in the Lagoon Area was often overlain by black cinders. At a depth of 0 - 4 feet, soils were silt and clay, with frequent observations of fill material and tar. At 4 - 8 feet, soils were similar to shallower soil with some natural organic matter (i.e. twigs, roots) and less evidence of tar observed. In deepest borings, 8 - 12 feet, silty clay and clay was also encountered, with one observation of possible tar. Refusal occurred at 8 to 11 feet in some borings, with weathered bedrock in the bottom of the sample core.

Soils in the Scraped Area were sometimes overlain by black cinders. As in the Lagoon Area, soils from 0-12 feet were silty clay and clay. Observations of tar decreased with depth, and no observations of tar were noted in the 8-12 feet borings.

7.1.2 Grid Expansion

The original Lagoon Area grid (prior to any expansion) contained 54 sampling locations and measured 240 by 150 feet. The final grid contained 103 sampling locations and measured approximately 330 by 380 feet. The original Scraped Area grid contained 24 sampling locations and measured 90 by 150 feet. The final grid contained 36 sampling locations and measured approximately 150 by 350 feet.

7.1.3 Immunoassay Results

In general, agreement between field immunoassay results and laboratory analyses conducted by the ABB-ES was high.

Of the 38 IA results which had confirmatory analysis conducted, there was one IA false positive, which did not cause any unnecessary expansion of the grid. In addition, there was one case, (LA-100-00-02), where a false negative was detected by the IA. Based on the IA result and the lack of visual or olfactory evidence of contamination, ABB-ES chose not to expand the grid from this point. Extension of the grid further to the northwest from LA-100 would have placed the next sampling point in the wooded area adjacent to the road. Based on the subsequent ABB-ES analyses which detected cPAH, it is possible that a small area of contamination exists between LA-100 and the road.

7.2 LABORATORY ANALYSIS

7.2.1 Metals

Sampling for the metal contaminants of concern (arsenic, cadmium, lead and copper) was conducted at a total of ten locations (ten samples and one field duplicate) in the two areas that were suspected to have elevated soil metals concentrations based on previous analytical results for the Site (Weston 1988). No soils with metals concentrations above the ROD-specified action levels were encountered, although some results above site background concentrations, as defined by Weston's background samples, were reported.

7.2.2 ABB-ES Wakefield Laboratory- cPAHs

Of a total of 179 samples analyzed from the Lagoon Area, 39 samples contained cPAH concentrations above the existing action level of 78 mg/kg. The majority of these detections were located at a depth of 0-4 feet, and were randomly distributed. Several were found to the south and southwest, outside of the original sampling grid. Although most detections of cPAHs in the Lagoon Area were in the surficial soils, there were adjacent sample points (LA-42, 43, 44, and 53) in the western corner of the original sampling grid where medium to high concentrations of cPAHs were identified in the 8-12 foot sampling depth interval. Excavation deeper than 12 feet may therefore be required in this small area.

Of the 77 samples analyzed from the Scraped Area, 12 samples contained cPAH concentrations above the existing action level of 78 mg/kg. All of these detections were located in the upper 4 feet of soil, and were located in the northeast and south of the sampling grid, primarily outside of the original grid.

"Areas of Concern" were identified in site walkovers during late 1995. Clearings to east & north of Scraped Area were noted: east of the Scraped Area, a small clearing with access for a vehicle was noted (SA -25); and to the north, areas of disturbed topography, absence of vegetation, and apparent waste materials on the land surface were observed during a site tour (SA-33). A mound to the southeast of the Scraped Area, approximately the size of an automobile was observed as an apparent unnatural topographic feature among the trees (SA-32). No cPAHs were detected in any of these sample locations, therefore these do not appear to be areas of contamination.

Of the 18 Drainage Swale #1 samples analyzed, 9 were above the existing 78 mg/kg action level, whereas 0 out of 10 of the Drainage Swale #2 and 1 out of 6 of the Drainage Swale #3 samples were above the action level. There appears to be a localized area of high cPAH contamination (concentrations above 1000 mg/kg) in Drainage Swale #1, in the DS1-03 to DS1-04 area.

7.2.3 cPAH Confirmation

Ten percent of the samples analyzed by the ABB-ES laboratory for cPAHs were sub-sampled and sent to IEA for confirmatory analysis. IEA analyzed these confirmatory samples by GC/MS, Method 8270.

The RPD goal established for this project was 40%. Results showed that 65% of the samples met the project goals, an additional 10% were in the RPD range of 41-75% and the remaining 25% samples had an RPD above 75%.

ABB-ES has statistically evaluated the duplicate sample results between the IEA and ABB-ES laboratories using regression analysis. The output from the regression analysis produced the following statistics:

- Slope of the regression line (ABB-ES values on the y-axis): 0.96
- 95% confidence interval on the slope: 0.81 to 1.12
- R squared: 0.824

7.2.4 Laboratory Data QC

7.2.4.1 ABB Wakefield Laboratory cPAH Results

cPAHs were analyzed by ABB-ES' Treatability Laboratory following Modified EPA Method 3550/8100. Quality control parameters were reviewed to evaluate the data quality and determine if data quality had been met and to qualify data as required.

The results from this data review indicates that all data are usable. Some data were qualified as estimated for reasons described.

The ABB-ES internal duplicate samples (2 out of 32) not meeting the 40% RPD goal were qualified as estimated.

Surrogate recoveries were met with the exception of 8 samples. In 7 cases, the surrogate recovery exceeded the 130% limit, which appears to be caused by matrix interference due to high levels of PAHs present in those soil samples. These data were qualified as estimated.
The results from Matrix Spike and Matrix Spike Duplicate analysis indicate that precision and accuracy criteria were met with the exception of SA-22-00-04. The corresponding samples were qualified as required for any compounds not meeting recovery and RPD goals.

7.2.4.2 ESE Metals Results

Ten samples and a field duplicate were received by ESE in Gainesville, FL for metals analysis. The data was reviewed for compliance with the EPA CLP National Functional Guidelines for Inorganic Data Review (1994) and the project workplan.

The analytical holding time of 180 days was met for all samples. All data are considered usable. Based on MS/MSD results all lead, cadmium, and arsenic data are usable but should be considered estimated values.

7.2.5 Geotechnical Analysis

Grainsize analyses revealed that the subsurface soils in the Lagoon and Scraped Area are primarily silt and clay. Stones larger than 3/4-inch in diameter were rarely observed. Drainage Swale soils were found to be primarily sand and silt, with some gravel.

TOC values varied widely between samples, as seen in the following summary:

- Drainage Swales: minimum 580 mg/kg to maximum 68,000 mg/kg
- Lagoon Area: minimum 940 mg/kg to maximum 89,000 mg/kg
- Scraped Area: minimum 1,700 mg/kg to maximum 50,000 mg/kg

7.3 cPAH Distribution/Excavation Volume Estimates

Based on a cPAH target of 78 mg/kg, on calculations described in Section 4.5, and on the areas shown in Appendix F, ABB-ES has estimated quantities of soil to be planned for excavation and treatment, as listed in Table 7-1.

Table 7-1: Estimated Soil Quantities Requiring Excavation and Treatment

Location	Area (sq ft)	Depth (ft)[1]	Volume (cy)
Lagoon Area	55,800	3-12	10,733
Scraped Area	9,800	2-5	2,244
Drainage Swales	5,500	1	204
		Total Volume (rounded up)	**13,500 cy**

1. Depth varies with sub-areas defined for calculations

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7.4 WETLANDS DELINEATION

A single jurisdictional wetland associated with the landfill in the northeastern portion of the property was identified. Although additional wet areas were encountered during the site walkover, these other habitats are primarily intermittent drainages that lack one or more wetland attributes. It was concluded that no other jurisdictional wetlands exist at, or immediately downgradient of, the property. The palustrine wetland located within the fenced area at OU1 is contiguous with a narrow wetland area adjacent to Drainage Swale #3 (Figure 3-1) that continues to the railroad tracks. Due to the close proximity of the wetland to the eastern edge of the landfill, capping activities are highly likely to result in impacts to the western portion of wetland. Drainage Swale remedial activities are not expected to have an extensive effect on the wetland.

7.5 FENCE INSTALLATION AND DRUM REMOVAL

Thirteen drums were present at OU1 prior to their removal in February 1996. The drums were appropriately overpacked, labeled, removed from the site, and transported under Olin's direction to an appropriate disposal location by a subcontractor.

The fence installed at OU1 is 3,197 feet long and consists of 11 gauge galvanized chain link, 6 feet high. Three strands of barbed wire discourage access over the top. Locked double drive gates, each 12 feet wide, provide vehicle access

Appendices:

A. Triad Engineering Inc., OU1 Survey
B. Soil Boring Logs
C. Laboratory Results
    Wakefield cPAH Results
    Confirmatory cPAH Results
    Metals
    Grainsize
    TOC
D. IEA/ABB Statistical Comparison
E. Analytical Methods
F. Basis for Calculations for Soil Volume above cPAH Target
G. Manifests and Certificates of Destruction for Drums
H. Laboratory QC Data
I. Law Environmental Audit Results